

4. ENVIRONMENTAL IMPACTS AND MITIGATION

4.1 TRANSPORTATION

4.1.1 Affected Environment

4.1.1.1 Regional Context

Consistency with Transportation-Related Plans and Policies

The City of Seattle's Comprehensive Plan adopts an "urban village strategy" for preferred growth in the city. Urban villages are those areas of the city that have been identified as conducive to pedestrian, bicycle, and transit use and to cohesive community development. Transit uses are strongly encouraged in the Comprehensive Plan, especially transit systems (including intermediate capacity transit such as the Green Line) that connect urban centers, urban villages, and manufacturing/industrial centers. The Green Line would connect the city's Uptown (Seattle Center) and Downtown (including Belltown, commercial core, and Pioneer Square urban villages), Urban Centers with the urban villages of Crown Hill, Ballard, Alaska (West Seattle) Junction, and Morgan Junction, and with the Interbay and SODO/Duwamish manufacturing/industrial centers. The Comprehensive Plan also adopts a Transit Priority Network for the City of Seattle, which includes the general route of the Green Line from Ballard through Interbay, Downtown Seattle, and the Duwamish area, to West Seattle. The Land Use and Neighborhoods Section (Section 4.3) further describes how the Green Line and land uses along its alternative alignments would fit into the context of the City's Comprehensive Plan, neighborhood plans, and zoning.

On a regional level, Puget Sound Regional Council (PSRC) is the federally designated Metropolitan Transportation Planning Organization (MPO) and state designated Regional Transportation Planning Organization (RTPO) of the central Puget Sound Region. As the MPO and RTPO for the central Puget Sound region, PSRC is responsible for developing a long-range regional transportation plan, preparing a short-range implementation strategy, and developing a Transportation Improvement Program (TIP) that includes all regionally significant projects, such as the Green Line. *Destination 2030: Metropolitan Transportation Plan for the Central Puget Sound Region* (PSRC May 2001) is the long-range transportation action plan for the Puget Sound region that provides the regional context for the Green Line project. Both *Destination 2030* and the *Six-Year Action Strategy 1999-2004* (PSRC January 1999) document travel trends in the Puget Sound area (King, Kitsap, Pierce, and Snohomish County). They predict that, with no significant improvements in regional transportation systems, there would be more congested roadways, slower travel speeds, and increased vehicle delays.

The City of Seattle's Comprehensive Plan echoed these findings, noting that average weekday traffic volumes at city limit screenlines have increased by 50 percent between 1980 and 1998. The Comprehensive Plan also provides the following forecasts:

- Without implementation of Seattle Comprehensive Plan policies that discourage use of single-occupant vehicles and encourage transit and non-motorized modes, the City of Seattle predicts that between 1990 and 2010, daily traffic volumes would increase by 31 percent at the north city limit and by 38 percent at the south city limit.
- With implementation of Comprehensive Plan goals and policies, which seek to promote environmental stewardship, change and manage travel behavior, and encourage use of transit and public transportation, the City of Seattle predicts that traffic volumes between 1990 and 2010 would increase by 14 percent at the north city limit and by 16 percent at the south city limit.

Major Transportation Facilities Near the Green Line

As described in *Destination 2030*, approximately 16,790 linear miles of roadways serve the central Puget Sound region. The interstate and state highway system, representing less than seven percent of the road network, accounts for nearly one-half of the region's vehicle miles traveled (VMT). SR 99 and SR 519 are the primary highway facilities that serve at least a portion of the Green Line alternative alignments. The South Spokane Street viaduct is also an important east-west connection in the project area.

SR 99 is a north-south highway that serves as an important regional link between Everett and Tacoma. Between the West Seattle Bridge and the Aurora Bridge, SR 99 is a four- to six-lane limited-access highway with average daily volumes of 65,000 to 85,000. However, since the Nisqually Earthquake occurred in 2001, experts have determined that there is a 1 in 20 chance that another earthquake could permanently close the viaduct in the next 10 years. A seismic event poses a great risk to the seawall as well.

SR 519, commonly known as S Royal Brougham Way, is an important thoroughfare for cars, trucks, and pedestrians in the SODO district. Improvements to the road are currently underway and would improve safety by separating the at-grade rail crossing with the Burlington Northern Santa Fe (BNSF) mainline and improve vehicle and freight access between I-90 and waterfront locations such as the Port of Seattle container terminals and Colman Ferry Dock. The South Spokane Street viaduct is a four-lane principal arterial that connects I-5 and SR 99 to the West Seattle High Level Bridge and has a daily volume of approximately 66,700. The City of Seattle currently has plans to widen the viaduct to facilitate the movement of freight and goods in the corridor by widening existing travel lanes, creating a new westbound weave lane to assist westbound vehicular merging movements from I-5, and improving the surface streets adjacent to the project.

Airports

The King County International Airport (Boeing Field) is located in the Duwamish industrial area less than three miles from the point where the Green Line would cross the Duwamish River on or adjacent to the West Seattle Bridge. Boeing Field averages 290,000 flight arrivals and departures annually, and the airport is a base for about 150 businesses, including air cargo companies, flight schools, charter operations, and helicopter services. Several hundred additional tenants are small aircraft owners who use planes for recreational and business purposes. Approximately three miles south of Boeing Field is Seattle-Tacoma International Airport, the largest air facility in the Pacific Northwest, which handled over 26 million passengers in 2002 and averages about 1,000 flight arrivals and departures daily.

4.1.1.2 Existing Transit Service

King County Metro Transit (Metro), Community Transit, Pierce Transit, and Sound Transit provide local, regional, and express public bus and commuter rail transit service to King County. In addition, the City of Seattle owns a monorail route on Fifth Avenue from Westlake Center to the east side of Seattle Center, which is operated by a local, private company. Sound Transit's Commuter Rail and Regional Express (bus service) are designed to add to the regional transportation network serving passengers traveling throughout the region. Greyhound and Amtrak also provide long-distance transit/rail travel options between Seattle and destinations throughout the continental United States. Both Metro and Sound Transit buses have a front rack for two bicycles for use by passengers free of charge.

King County Metro

King County Metro (Metro) serves passengers in King County with fixed route local and express bus services, including express services operated cooperatively with Sound Transit. It also provides demand-response (DART¹), Americans with Disabilities Act (ADA) paratransit, vanpool, and ride matching services and operates the Downtown Seattle George Benson Waterfront Streetcar Line. Most routes operate into the evening and on weekends. Midday service frequency is typically 15 to 30 minutes in the denser portions of the urban area and 30 to 60 minutes in the more suburban areas. Peak period service is more frequent.

King Street Station provides opportunities for intermodal connections to areas throughout Seattle, as well as regional and interstate connections. Currently, intermodal services provided at or near King Street Station include Metro bus connections, Sounder commuter rail services, and Amtrak passenger rail. Future connections include Sound Transit's Link light rail and the Green Line. See Appendix I, Projects to Consider for Cumulative Impacts Analysis, for a discussion of future King Street Station area improvements.

Metro is implementing a Six-Year Plan (2002-2007) that emphasizes a focus on "core service connections" served by "core routes," with improvements in service levels, passenger facilities, reliability, speed, and operations. Designated core connections parallel parts of the Green Line and otherwise serve all Green Line station areas. Within the larger group of core connections, a subset of "priority" corridors is identified in the Six-Year Plan. "Priority" core bus routes serve several Green Line station alternatives in Ballard, Queen Anne, and Downtown.

In addition, Metro is working with private developers to establish transit-oriented development projects at the following locations near the Green Line alternative alignments: the Seahawks Stadium (formerly Kingdome) north parking lot adjacent to the Green Line Weller/King Street station alternatives, Convention Place, and the Denny Triangle.

Metro has one park-and-ride lot along the Green Line alternative alignments. The SW Spokane Street park-and-ride lot is located near the West Seattle Bridge in West Seattle. This park-and-ride lot provides service throughout the day to six transit routes that travel along and near the Green Line alternative alignments. These transit routes include routes 21, 22, and 56; in addition, routes 37 and 57 provide peak-hour service and route 85 provides night owl service.

A number of major transfer points exist along the Green Line alignment. These transfer points are described as follows.

- There are four transfer points that provide transit service along the Ballard Segment of the Green Line alignment. Eight routes, including routes 15, 17, 18, 44, 46, 48, 75, and 81 (a night owl route) serve one or more of these transfer points. These transfer points include:
 - 15th Avenue NW and NW 85th Street
 - 15th Avenue NW and NW Market Street
 - Ballard Avenue NW and NW Market Street
 - 15th Avenue NW and Leary Way NW

¹ Dial-A-Ride Transit

Both the 15th Avenue NW and NW 85th Street, and 15th Avenue NW and NW Market Street bus stops are in close proximity to the Green Line stations.

- The 15th Avenue W and W Nickerson Street transfer point is located in the Interbay Segment of the Green Line alignment. At this transfer point, routes 17 and 31 travel along Nickerson Street, and routes 15, 17, 18, and 81 (a night owl route) travel along 15th Avenue W.
- The Queen Anne Avenue N/First Avenue N and Mercer Street transfer point is located in the Queen Anne/Seattle Center/Belltown Segment of the Green Line alignment. Queen Anne Avenue and First Avenue N function as a one-way couplet, with northbound transit service along Queen Anne Avenue and southbound transit service along First Avenue N. Routes 1, 2, 8, 13, 15, 18, 45 and 74 travel northbound and southbound on Queen Anne Avenue and First Avenue N.
- In Downtown Seattle, there are transfer points both on the surface streets and in the Downtown Seattle Transit Tunnel.
 - There are a number of bus stops on Third Avenue. Third Avenue at Pike Street and Pine Street is considered to be the major bus transfer point, providing access to routes 1, 2, 3, 4, 5, 7, 10, 11, 12, 13, 14, 16, 20, 36, 43, and other surface routes as well as to the Downtown Seattle Transit Tunnel.
 - The Downtown Seattle Transit Tunnel (DSTT) has a total of five bus transit stations that are used by 24 local and regional bus routes. In total, 145 buses (72 northbound, 73 southbound) are routed through the tunnel during the p.m. peak hour. The following four DSTT stations are in close proximity to the Green Line: Westlake Station, University Street, Pioneer Square, and International District.
- The Chelan Avenue SW and SW Spokane Street, Alaska (West Seattle) Junction, and 35th Avenue SW and SW Avalon Way are the major transfer points in West Seattle.
 - The Chelan Avenue SW/SW Spokane Street transfer point is located near the SW Spokane Street park-and-ride lot. A total of eight routes use this transfer point. All of these routes, including route numbers 20, 21, 22, 37, 56, 57, 85, and 135 provide service along a portion of the Green Line alignment.
 - The 35th Avenue SW and SW Avalon Way transfer point is located at the 35th Avenue SW/SW Avalon Way intersection. A total of nine routes serve this transfer point. These routes include 21, 22, 53, 54, 55, 116, 118, 119, and ST 570. Most of these routes currently provide transit service along a portion of the Green Line alignment. The 35th Avenue SW and SW Avalon Way transfer point is located near the 35th Avenue SW/SW Avalon Way Green Line station alternatives.
 - The Alaska (West Seattle) Junction transfer point is located on SW Alaska Street west of California Avenue SW. A total of 10 routes currently serve this transfer point. These include routes 22, 37, 51, 53, 54, 55, 57, 85, 128, and ST 560. Sound Transit Regional Express route 560 also provides service to this transfer point. Transit riders can transfer to other routes in the system at these transfer points.

Sound Transit

Sound Transit currently operates three transit facilities and services programs, Sounder commuter rail, Regional Express bus service, and Link light rail transit (LRT) in Tacoma. Sound Transit is also in the process of constructing the Initial Segment of Central Link light rail, scheduled for opening in 2009, which would extend from just north of Seattle-Tacoma International Airport to Westlake Station in the Downtown Seattle Transit Tunnel underneath Westlake Center. In the future, LRT could be extended

north to either the University District or Northgate Transit Center, but this segment is still in the environmental review phase.

Sounder is a commuter rail service that connects Downtown Tacoma to Downtown Seattle. Future segments of the Sounder commuter rail system are planned between Seattle and Everett and between Tacoma and Lakewood. Currently, Sounder provides one-way service during peak weekday commute times between Tacoma and Seattle. Once in full operation, it would operate on 82 miles of track between Everett and Lakewood. In Downtown Seattle, Sounder operates out of King Street Station. The Green Line's Weller/King station would be within walking distance (less than one block) of King Street Station.

Sound Transit Regional Express is a regional bus service that operates in partnership with Community Transit, Everett Transit, King County Metro, and Pierce Transit. The collaboration is intended to allow these agencies to focus on services within their areas, and provide connections to the regional bus and commuter rail network. Sound Transit route 560 provides transit service that extends from the Bellevue Transit Center to Seattle-Tacoma International Airport to the West Seattle Junction transfer point. At this location, riders can transfer to Metro bus routes that serve West Seattle and Downtown Seattle. In addition to these services, Sound Transit, working in conjunction with its regional transit partners, has developed a Regional Accessible Transit Guide that brings together accessible fixed-route, paratransit and Medicaid transportation information for the three-county Central Puget Sound Region. Sound Transit and its transit partners follow the accessibility standards of the Americans with Disabilities Act (ADA) and ADA Standards for Accessible Guidelines (ADAAG). Sound Transit follows additional guidelines for all Sound Transit facilities and vehicles.

Other Transit Facilities

Other transit facilities that currently enhance transit service reliability in the vicinity of the Green Line alternative alignments include the following:

- Amtrak provides cross-country passenger rail services in both the north-south and east-west directions from the King Street Station in Downtown Seattle. In Seattle, passenger trains operate daily, providing service to Vancouver, B.C., Bellingham, Washington, Portland and Eugene, Oregon, Los Angeles, California, and Chicago, Illinois.
- The Downtown Seattle Transit Tunnel (DSTT) allows buses to avoid surface street traffic congestion in downtown. The DSTT currently serves approximately 145 buses (72 northbound, and 73 southbound) during the p.m. peak hour. Sound Transit has proposed to close the DSTT between the years 2007 and 2009 to convert the tunnel to joint light rail/bus operations; however, there is the potential that this closure could begin as early as 2005.
- Greyhound Lines, Inc. operates interstate and regional bus service from a Downtown Seattle terminal on Stewart Street between Eighth and Ninth Avenues. The terminal is located three blocks east of Westlake Center, the existing Seattle Monorail Station and DSTT.
- The South E3 Busway is an exclusive busway that connects to the south end of the DSTT and extends south to Spokane Street. This busway allows King County Metro and Sound Transit buses to bypass congestion on I-5 and Fourth Avenue S south of Downtown Seattle.
- The D-2 roadway is a shared-use facility for buses and HOVs connecting Fourth Avenue S, east of the Seahawks stadium, with the I-90 center roadway.
- HOV lanes on I-5 and I-90, and the eastbound transit-only lane on the West Seattle Bridge improve travel time and reliability for buses to and from major population and employment centers. A transit-priority lane on Second and Fourth Avenues allows transit vehicles to move efficiently through Downtown Seattle.

Ferry System

Washington State Ferry terminals in the vicinity of the Green Line alternative alignments are located in Downtown Seattle (Colman Dock) and in West Seattle (Fauntleroy). Vehicle ferries to and from Bremerton and Bainbridge Island and passenger-only ferries to and from Bremerton and Vashon Island dock at Colman Dock. On an average weekday, approximately 47,250 passengers either walk on the vehicle ferry or use the passenger-only ferry from Colman Dock. These trips make up approximately 56 percent of the total number of ferry passengers (walk-on and vehicle) between these destinations and Downtown Seattle. Vehicle ferries to and from Vashon Island and Southworth (Kitsap County) are located at Fauntleroy Ferry Terminal. The Colman Dock ferry terminal is located on Alaskan Way, between Madison and Marion Streets. This is approximately two blocks west of the Green Line Madison station alternatives and is near the Yesler station alternatives. The West Seattle Fauntleroy ferry terminal is located just south of Lincoln Park on Fauntleroy Way SW. The ferry terminal is located south of any of the Green Line station alternatives; however, bus routes are available from both the Alaska Junction and 35th Avenue SW/SW Avalon Way Green Line station alternatives to the ferry terminal.

King County also operates the Elliott Bay Water Taxi on a seasonal basis between Seacrest dock in West Seattle and Pier 54, near Madison Street in Downtown Seattle.

4.1.1.3 Arterials and Local Streets

All six segments studied for the Green Line would be affected by different alignment and station alternatives. Information on existing traffic volumes and level of service, historical accident data, an inventory of existing pedestrian and bicycle connections, on-street parking supply and demand, and key freight roadways that could potentially be affected by the Green Line alternatives were collected and evaluated for each segment. The results of these evaluations are provided in Appendix OO, Transportation Backup Information.

Methodology

The methodologies used to evaluate the affected arterial and local street system are described below.

Traffic Volumes and Level of Service

The quality of traffic operations on roadway facilities is described in terms of level of service (LOS), a measure of operational conditions and motorists' perception. The Highway Capacity Manual (HCM) methodology is typically used for calculating LOS at signal-controlled and stop-controlled intersections. For signalized intersections, LOS is related to the average delay experienced by all vehicles as they approach the intersection. For all-way stop controlled intersections, LOS is related to the delay for the entire intersection. For unsignalized two-way stop controlled intersections, LOS is based on the approach that would experience the greatest delays, or worst LOS. Table 4.1-1 summarizes the relationship between LOS and delay for intersections.

As described in Table 4.1-1, LOS ratings range from 'A' to 'F'. LOS A represents the best operation and LOS F the poorest operation. LOS D or E is usually considered the minimum acceptable standard in urban areas. With this level of service, some delays are expected for certain traffic movements. At LOS F, long delays are experienced at intersections. Some contributing factors to LOS F conditions include long cycle lengths, poor signal progression for certain movements, poor signal timing, and overcapacity conditions. For concurrency planning purposes, the City of Seattle defines arterial level of service standards based on the p.m. peak hour directional volume/capacity (v/c) ratio at designated screenlines. (A screenline is an imaginary line across two or more parallel arterials). The total volume for arterials

crossing the screenline is compared to the total capacity to determine if the LOS threshold has been exceeded. The level of service standard is 1.0 (LOS E) at more than half of the screenlines identified in the Comprehensive Plan. The remaining screenlines, including many of the screenlines in the vicinity of the Green Line alternative alignments, have a v/c ratio of 1.2 (LOS F). At a LOS standard of 1.20 or greater, traffic congestion and vehicle queuing at intersections would be expected. When the calculated LOS for a screenline approaches the LOS standards, strategies could be pursued to reduce vehicular travel demand and/or increase the operating capacity across the screenline.

Table 4.1-1. Level of Service Criteria for Intersections

Level of Service	Unsignalized Control Delay (seconds per vehicle)	Signalized Average Delay (seconds per vehicle)	Traffic Flow Characteristics
A	≤ 10.0	≤ 10.0	Virtually free-flow; completely unimpeded.
B	> 10.0 - ≤ 15.0	> 10.0 - ≤ 20.0	Stable flow with slight delays; less freedom to maneuver.
C	> 15.0 - ≤ 25.0	> 20.0 - ≤ 35.0	Stable flow with delays; less freedom to maneuver.
D	> 25.0 - ≤ 35.0	> 35.0 - ≤ 55.0	High density but stable flow.
E	> 35.0 - ≤ 50.0	> 55.0 - ≤ 80.0	Operating conditions at or near capacity; unstable flow.
F	> 50.0	> 80.0	Long delays experienced at intersections. Vehicles are typically delayed for more than one signal cycle.

Source: Highway Capacity Manual (2000).

The City of Seattle also applies State Environmental Policy Act (SEPA) review policies to determine transportation mitigation for individual projects. Specifically, Transportation Policy B (SMC 25.05.675R2b) states:

“In determining the necessary traffic and transportation mitigation, the decision-maker shall examine the expected peak traffic and circulation pattern of the proposed project weighted against such factors as the availability of public transit; existing vehicular and pedestrian traffic conditions; accident history; the trend in local area development; parking characteristics of the immediate area; the use of the street as determined by the Seattle Transportation Department’s Seattle Comprehensive Plan; and the availability of goods and services and recreation within reasonable walking distance.”

Since this SEPA policy does not establish specific LOS thresholds for transportation mitigation, the LOS E threshold was used to determine whether mitigation should be considered at a particular intersection. This LOS threshold is also supported by the statement in the SEPA policy “the availability of public transit,” since the Green Line will enhance the availability of public transit services at intersections evaluated around each of the Green Line stations.

Intersections that could be affected by the Green Line were analyzed using the Synchro version 5.0 model. This software program replicates the signalized intersection capacity analysis as specified in the *Highway Capacity Manual*, 2000 Edition. Traffic counts collected for use in the affected environment analysis span a time period from 2000 to 2003. The traffic counts represent the existing traffic volumes at each intersection and were used as a basis for the LOS analysis. Pedestrian and heavy vehicle counts were collected by approach and are also represented in the LOS analysis. A minimum of 50 pedestrians per hour was assumed at all study intersections except in cases where the pedestrian counts were greater. Signal timing used for the analysis was based on information received from SDOT or obtained from field observations.

Traffic volumes along the Green Line alternative alignments as a whole are typically higher during the p.m. peak period than during the a.m. peak period (except in some limited areas where a.m. peak hour analysis was also conducted), and therefore p.m. peak hour volumes represent a conservatively high estimate of potential impacts from the Green Line. The LOS analysis primarily focused on the p.m. peak hour to evaluate this conservative range of potential conditions for intersections along the Green Line. The a.m. peak hour was also evaluated at select locations where a.m. peak directional travel patterns would be affected by placement of the Green Line alignment infrastructure in the existing right-of-way (i.e., resulting in the loss of a travel lane or turn lane). The a.m. peak hour was also evaluated at select intersections near station areas where new trips generated by Green Line patrons during the a.m. peak hour could potentially affect traffic operations. These locations were determined in coordination with City of Seattle staff.

Traffic Accidents and Safety

A preliminary review of accidents that have occurred during the years 2000 through 2002 was conducted at all intersections along the Green Line alternative alignments identified for traffic analysis. This three-year accident history was obtained from the City of Seattle, and the results of this review were compiled for each segment. In addition, the City of Seattle annually conducts a multi-level review of collision data to identify areas with the most pressing safety concerns and to help prioritize traffic safety improvements. Intersections are first screened to identify potential High Accident Locations (HALs). These include signalized intersections with 10 or more collisions in 12 consecutive months and unsignalized intersections with five or more collisions in 12 consecutive months. For these potential HALs, a detailed review of collision reports is conducted to remove reports that are misfiled, misreported, or otherwise incorrect. In some cases, locations initially identified as potential HALs are removed from this classification. In addition, locations identified as HALs in one year may no longer be considered HALs in subsequent years if accident rates drop below the ten- or five-accident threshold. Intersections identified as potential HALs are discussed in further detail for each segment.

Pedestrian and Bicycle Circulation

A survey of existing facilities was generally conducted for pedestrian and bicycle connections within a ½-mile radius of each station alternative in each segment of the Green Line alternative alignments. For analysis purposes, a ½-mile distance was assumed to represent reasonable travel distances for pedestrians and bicyclists accessing a transit station. These distances are commonly used as standards in transportation analysis.

The City of Seattle's GIS system and the Seattle Bicycling Guide Map was used to provide a general overview of existing bicycle facilities (including separated, multi-use trails; on-street bicycle lanes; roadways with wide curb lanes, lanes, or shoulders; and arterial and residential streets commonly used by bicyclists) and to identify gaps in the non-motorized transportation network. The City of Seattle's GIS system was also used to identify mid-block pedestrian signal locations, public and private schools, and designated school walk routes for each segment, and to provide an inventory of missing sidewalk segments within a 1/2-mile radius of each station alternative. Some field spot checks were conducted to verify missing sidewalk segments and curb ramps along arterial streets immediately adjacent to the Green Line station alternatives. The analysis focused on non-motorized connections along arterial streets rather than residential streets, since arterials generally have higher volumes of vehicular and non-motorized traffic and hold the greatest potential for safety issues and conflicts.

Parking Supply and Demand

The analysis for parking supply, demand, and utilization focused on areas with the greatest potential impact from the Green Line, particularly within an approximate ¼-mile radius of station alternatives.

This is considered a reasonable walking distance between a parking space and a transit station. To maintain consistency in the analysis methodology, a ¼-mile radius was evaluated for each station area, regardless of topography and variations in the roadway network. Green Line stations could affect parking availability if passengers park in residential neighborhoods or commercial areas with unrestricted parking. This type of parking is referred to as “hide-and-ride.”

Space occupancy counts were conducted by block face, taken once between 9:30 a.m. and 3:30 p.m. on a weekday. This time period was determined to represent “typical” conditions for parking demand based on the type of land use surrounding each of these station areas.

Where possible, parking supply was determined based on actual counts of clearly marked parking spaces (i.e., at parking meters). Where parking spaces were not clearly marked, a visual assessment of parking supply was made and/or parking supply was estimated assuming approximately 20 feet per parking space. This assumed spacing is consistent with the City of Seattle’s Client Assistance Memo 117, which estimates that approximately one parking space could be provided within a distance of 16 to 31 feet. Required clear distances from common street features such as intersections, driveways, fire hydrants, and special zones (i.e., no parking or bus zones) were also considered in the parking surveys.

Parking supply and utilization data were collected and summarized in the following two categories:

- On-street unrestricted – includes all on-street parking not restricted by meters, time limit signs, residential parking zones, loading zones, or other restrictions.
- On-street restricted – includes all on-street parking currently restricted by one of the above methods.

This information can be used to identify where future impacts from the Green Line alternative alignments and stations could be more significant and/or parking mitigation could be required. Where midday parking utilization exceeded a 75 percent threshold, an additional early morning parking survey of on-street unrestricted spaces was conducted between 6:00 and 8:00 a.m. Early morning surveys were also conducted near all station alternatives in the Ballard and West Seattle Segments, due to their locations in residential neighborhoods and proximity to the Green Line termini. Restricted parking spaces were not surveyed again during the early morning hours, since Green Line passengers would not typically use these spaces.

Freight Roadways

In 1990, the Washington State Legislature directed the Legislative Transportation Committee (LTC) to examine the use of the state highway system for truck freight transportation. The State’s Transportation Committee adopted the Freight and Goods Transportation System (FGTS) that resulted from this legislation. The resulting classifications range from T-1, which includes roadways that carry over 10,000,000 tons per year, to T-5, which includes roadways that carry over 20,000 tons in 60 days (used only in agricultural areas). Table 4.1-2 summarizes the classifications and the corresponding tonnage and approximate number of large trucks per day for each category. Table 4.1-2 reflects revisions made in 2001 to the annual gross tonnage limits for T-2 facilities.

In the City of Seattle, every arterial street is designated as a truck street to serve local truck traffic; however, only those arterials designated as “Major Truck Streets” in the Comprehensive Plan are meant to serve both local and non-local truck traffic. The City of Seattle has two manufacturing and industrial districts designated in the Comprehensive Plan – the Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) and the Duwamish area. Mobility from these areas to major regional and interstate routes is critical to businesses region-wide. The number of key freight roadways is higher

through the industrial area south of Downtown Seattle, as the existing land use patterns and concentrated industrial activity result in higher levels of truck traffic.

Table 4.1-2. Freight and Goods Transportation System Classifications

FGTS Classification	Annual Gross Tonnage	Approximate Number of Large Trucks per Day
T-1	Over 10,000,000	Over 800
T-2	4,000,000 to 10,000,000	320 to 800
T-3	300,000 to 4,000,000	24-320
T-4	100,000 to 300,000	8 to 24
T-5	Over 20,000 in 60 Days	

Source: Washington State Department of Transportation, 2003.

Vehicles or loads exceeding the maximum height, width, and/or length, as specified by State and City laws, are required to obtain a special permit and may use designated truck routes during off-peak hours between Monday and Friday (no movements between 6:00 to 9:00 a.m. and 3:00 to 7:00 p.m.). Certain oversized loads require a police escort and are limited to travel between 3:00 to 5:00 a.m.

Previous studies of truck freight within the City of Seattle and the Puget Sound region have demonstrated that most truck activity occurs during daytime hours between 9:00 a.m. and 4:00 p.m. Generally, truck volumes decline between the hours of 4:00 p.m. and 7:00 p.m. and represent a small fraction of afternoon peak commuter traffic.

4.1.1.4 Railroad Mainlines and Spur Tracks

Two of the nation's largest railroads operate in Seattle: the Burlington Northern-Santa Fe (BNSF) and Union Pacific-Southern Pacific (UPSP). The BNSF Railroad owns and operates a dual-track mainline that connects Portland, Oregon, to Everett, Washington. From Everett, the BNSF mainline splits, with one branch turning east over Stevens Pass to Chicago and the other continuing north to Canada. The UPSP Railroad owns and operates a two-way single mainline track between Tacoma and Seattle. UPSP Railroad's primary service terminates at its Seattle (ARGO) yard, south of S Spokane Street. However, UPSP currently moves approximately five grain trains per day along the BNSF mainline to the Cargill Grain Elevator in the Interbay Segment west of Elliott Avenue W. Otherwise, the UPSP railroad does not affect roadways north of S Spokane Street.

Rail activity along the mainline tracks within the vicinity of the Green Line alternative alignments occurs 24 hours per day, seven days per week. Although the passenger trains operated by Amtrak and Sound Transit have fixed schedules, freight trains arrive and depart based on shipping needs and mainline capacity constraints.

Sound Transit provides commuter rail service between Seattle and Tacoma along the BNSF Railroad mainline, with service to Everett planned to start later in 2003. Commuter rail service has been operating since September 2000, with seven northbound trains arriving at the King Street Station between 7:15 a.m. and 7:45 a.m. and seven southbound trains departing between 4:55 p.m. and 5:35 p.m. Daily weekday ridership averages almost 3,000 passengers. Amtrak provides three daily passenger rail trains to Vancouver, B.C., Bellingham, WA, and Chicago, IL. The following describes the existing rail network and rail activity for affected segments in the study area.

Ballard Segment

The BNSF dual-track mainline travels along Shilshole Bay and does not pass near any of the Green Line alignments in the Ballard Segment. However, a connecting spur on the north side of the Ship Canal, franchised to the Ballard Terminal Rail Company, serves the Ballard and the western Ship Canal areas. All Green Line alternatives would cross over this railroad spur on an elevated structure.

Interbay/Magnolia Segment

The BNSF line west of Elliott Avenue W and 15th Avenue W passing through the Interbay/Magnolia Segment is a major west coast freight corridor. In 2001, over 60 trains per day including, 20 regional intermodal trains, 25 local freight trains, and 10 local trains, traveled to or from the adjacent Interbay Yard, or used this rail line.² The Interbay Yard is a major west coast locomotive servicing facility for BNSF located north of Dravus Street. This rail line and the Interbay Yard are located west of the Green Line alternative alignments. The Green Line would cross a BNSF spur line that crosses under the south approach to the Ballard Bridge.

In addition to freight rail, the BNSF line also accommodates passenger rail. There are presently three daily Amtrak trains through Interbay in each direction. One each originates or terminates in Bellingham, Chicago, and Vancouver B.C. All serve intermediate stations. The northern Sound Transit Sounder commuter rail line began service in late 2003. None of the existing or potential additional commuter trains would pass directly under the Green Line alignment.

Downtown/Pioneer Square Segment

In the Downtown/Pioneer Square Segment, the BNSF Railroad mainline crosses under Downtown Seattle through the King Street Tunnel. At approximately Seneca Street, the tunnel aligns directly under, and parallel to, Fourth Avenue. The tunnel begins north of S Jackson Street in Pioneer Square and ends below the Pike Street Market on the Elliott Bay waterfront near Pier 62/63.

SODO/Chinatown International District/Pioneer Square Segment

There is substantial railroad infrastructure in the SODO/Chinatown International District/Pioneer Square Segment. South of King Street, the BNSF mainline exists at grade along the west side of Fourth Avenue S and continues south towards Second Avenue S. The BNSF Seattle International Gateway (SIG) intermodal terminal and its adjacent Stacy classification and storage yard are located in the SODO Segment between S Atlantic Street, S Hanford Street, Third Avenue S, and SR 99. Intermodal service is provided from the SIG terminal seven days a week. The King Street Amtrak station is located in SODO at Fourth Avenue/Jackson Street, and the UPSP yards are located just south of the SODO/Chinatown International District/Pioneer Square Segment in the Georgetown area.

Two primary spur tracks branch off of the BNSF mainline to the north between I-5 and Fourth Avenue S. These spur tracks branch again north of Spokane Street to create approximately five separate north/south spur tracks between I-5 and Fourth Avenue S. Two of the spurs are located on either side of Fifth Avenue S (Fifth Avenue S serves as the E-3 Busway for Metro buses). Two additional spurs extend across S Lander Street at approximately Seventh Avenue S and Eighth Avenue S, resulting in four tracks crossing at S Lander Street between Seventh Avenue S and Eighth Avenue S. Finally, one spur is located along the west side of I-5 east of Airport Way; it does not cross S Lander Street since Lander ends at Airport Way. The BNSF line has a daily volume of approximately 26 freight trains and eight Amtrak passenger

² Daily train data from Burlington Northern Santa Fe (BNSF), May 2001, as shown in the West Galer Street Closure Study Executive Summary, by K2 & Associates Inc., May 2001.

trains. Six Sounder commuter trains (three in each direction) also operate on the BNSF tracks between Seattle and Tacoma. The UPSP line has a daily volume of approximately 12 trains.

West Seattle Segment

The West Seattle Segment includes a BNSF bridge across the Duwamish Waterway, with rail lines connecting to Terminal 3 and Pier 2 between W Marginal Way and Harbor Avenue SW. A BNSF track also exists south of the West Seattle Bridge along W Marginal Way. Both BNSF and UPSP lines extend south of the West Seattle Bridge on the east side of the Alaskan Way Viaduct/SR 99, with the UPSP intermodal terminal located on Denver Avenue at Second Avenue. The Port of Seattle operates an intermodal facility at Terminal 18 on Harbor Island, which is served by BNSF railroad tracks. There is also a rail spur into the Nucor steel plant.

4.1.1.5 Navigable Waterways

Ballard Segment

The Lake Washington Ship Canal connects Puget Sound with Lake Washington and serves water-dependent businesses and marinas in Interbay, Ballard, Fremont, Lake Union, Portage Bay, Kirkland, Kenmore, and Renton. The canal is a regulated water level waterway and also a federally regulated navigable waterway with delineated combined bulkhead and pier lines. Depths through the Ship Canal channel are equal to or greater than 30 feet, except at the Ballard Locks, which has a depth of 29 feet over sills. Near the Ballard Bridge, the main channel is surrounded by areas with depths below 20 feet. An area located west of the existing bridge and south of the main channel, with water depths ranging between approximately 20 and 26 feet, is currently used as a turning basin for large ships. This turning basin area is shown on the map attached in Appendix P, Navigation Backup Information.

Each bridge has a permit over the Ship Canal with the U. S. Coast Guard for a navigation channel vertical and horizontal clearance envelope. Any new bridge structure must obtain a permit from the U. S. Coast Guard that will specify the horizontal and vertical clearances required for the reasonable needs of maritime navigation. Table 4.1-3 summarizes the navigational clearances for all existing bridges between Puget Sound and Lake Union. Clearance for the I-5 Bridge (between Lake Union and Lake Washington) is also included because that bridge is the only fixed-span bridge between Lake Union and Lake Washington. Currently, the Aurora Bridge is the only fixed-span bridge between Lake Union and Elliott Bay. The monorail-only bridge for the Green Line would add a second fixed-span bridge between Lake Union and Elliott Bay.

As shown in Table 4.1-3, the Ballard Bridge, a bascule bridge (counterweighted drawbridge) built across the Ship Canal in 1917, has a vertical clearance of 46 feet above water and a horizontal clearance of 150 feet. The Aurora Bridge, located west of Lake Union, limits vertical navigational clearance between Puget Sound and Lake Union to 135 feet above mean water level. Between Lake Union and Lake Washington, the I-5 Bridge limits vertical navigational clearance between Lake Union and Lake Washington to 127 feet over mean water level. Between Puget Sound and Lake Union, the limiting navigational width in the Ship Canal is 80 feet at the locks.

Between 1993 and 2002, the Ballard Bridge averaged 5,705 openings per year. The number of openings has decreased each year during that period so that only 4,859 openings occurred in the year 2002. Table 4.1-4 summarizes the annual and monthly number of Ballard Bridge openings that have been recorded between the years 1993 and 2003.

Table 4.1-3. Existing Bridge Navigational Clearance

Bridge	Height Above Water ^a	Width Restrictions
Ballard Locks	N/A	80 feet
Ballard Bridge (draw-span)	46 feet	150 feet
Fremont Bridge (draw-span)	14 feet	150 feet (120 feet open)
Aurora Bridge (SR 99)	135 feet	150 feet
I-5 Bridge	127 feet	250 feet

^a Vertical clearances are referenced to mean water level (21 feet above mean lower low water [MLLW]). Lake Washington water surface elevation is regulated by the locks and is 2 feet lower during winter months to reduce waterfront/beach erosion; elevations correspond to high regulated lake level.

Source: Nautical Chart No. 18447, U.S. Department of Commerce National Oceanic and Atmospheric Administration.

Table 4.1-4. Ballard Bridge Monthly and Annual Bridge Openings (1993 to 2003)

Month	Year											10-Year Average (1993 to 2002)
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
January	324	354	358	343	346	367	342	348	327	344	278	345
February	339	255	300	321	367	308	284	292	268	248	255	298
March	518	479	459	536	452	427	420	386	388	303	326	437
April	588	550	444	500	500	500	443	451	458	411	360	485
May	693	730	508	597	663	629	617	527	575	558	537	610
June	691	662	585	583	621	533	586	618	531	525	N/A	594
July	719	722	658	694	658	650	609	622	604	533	N/A	647
August	792	703	655	732	722	645	583	660	557	540	N/A	659
September	664	650	616	525	511	531	602	542	536	537	N/A	571
October	643	471	500	456	413	451	440	408	339	351	N/A	447
November	422	331	339	330	340	369	283	265	279	251	N/A	321
December	346	331	307	280	325	248	269	271	282	258	N/A	292
Annual Total	6,739	6,238	5,729	5,897	5,918	5,658	5,478	5,390	5,144	4,859	N/A	5,705
Monthly Average	562	520	477	491	493	472	457	449	429	405	351	475

Source: City of Seattle Ballard Bridge Monthly Openings Logs, June 2003. This information, as well as 2000-2003 daily Ballard Bridge openings logs containing vessel identifications, tonnages, and towages, are incorporated by reference.

As shown in Table 4.1-4, the number of openings varies seasonally, with the highest number of openings typically occurring between May and September, and the fewest openings occurring in November, December, and February. In May 2003, an average of 17 vessels per day required bridge openings with an average duration of four minutes. The daily number of openings varied between 10 and 27 per day, with durations ranging from three to ten minutes each. Vessels using the Ship Canal range from small recreational boats to large industrial ships. Total vessel usage is not kept for the Ballard Bridge area, but the U. S. Corps of Engineers keeps records on the total number of vessels passing through the Hiram M. Chittenden locks, located just to the west of the Ballard Bridge area between Lake Union and Elliott Bay. Table 4.1-5 summarizes the annual and monthly number of vessels that have been recorded between the years 2000 and 2003.

Table 4.1-5. Annual and Monthly Number of Vessels Using Hiram M. Chittenden Locks (2000 to 2003)

Month	Year				3-Year Average (2000 to 2002)
	2000	2001	2002	2003	
January	1,316	2,389	1,707 ^a	2,034	1,804
February	2,072	2,233	1,788	1,890	2,031
March	2,985	2,624	2,270 ^b	1,976	2,626
April	4,064	3,598	3,342	3,010	3,668
May	6,050	6,828	5,625	6,108	6,168
June	6,790	5,792	6,127	N/A	6,236
July	9,258	9,133	9,503	N/A	9,298
August	10,298	10,127	11,043	N/A	10,489
September	7,631	8,032	7,665	N/A	7,776
October	4,539	3,507	3,675	N/A	3,907
November	2,672	2,369	2,472 ^c	N/A	2,504
December	1,990	1,692	1,661	N/A	1,781
Annual Total	59,665	58,324	56,878	N/A	58,289
Monthly Average	4,972	4,860	4,740	3,004	4,857

^a Large Locks closed January 23, 2002 from 8:00 a.m. to 4:00 p.m. and on January 31, 2002 from 8:00 a.m. to 4:30 p.m.

^b Small Locks closed March 18-29, 2002.

^c Large Locks pumpout November 12-26, 2002 from 4:00 a.m. to 4:00 p.m.

Source: United States Corps of Engineers, July 2003.

As shown in Table 4.1-5, the number of vessels traveling through the locks varies seasonally, with the highest number of vessels recorded between May and September, and the fewest vessels recorded in December and January. Between January 2000 and June 2003, a total of 189,885 vessels, or an average of 58,289 vessels per year, were reported to have traveled through the Hiram M. Chittenden locks. Larger ships (requiring over 46 feet vertical clearance) using the Ship Canal between Lake Union and Elliott Bay are shown on the charts documenting Ballard Bridge openings (see Appendix P of the Draft EIS).

The Ship Canal does not accommodate container ships due to vessel size limitations at the Ballard Locks. To identify the needs of the larger vessels using the Ship Canal for passage between Lake Washington, Lake Union, and Elliott Bay, SMP interviewed the largest marine users in the area. Summary forms and charts from those interviews are attached in Appendix P of the Draft EIS. Information on maritime users with larger vessels was also obtained from the *Trans-Lake Washington Project, Ship Canal and Lake Washington Navigational Study* prepared by the Washington State Department of Transportation (WSDOT) (December 2001). Maritime users with vessels having special navigational requirements include the following:

- The University of Washington's Oceanography Department operates two large research vessels that use the Ship Canal. These vessels are moored in Portage Bay. The largest vessel is the Thomas G. Thompson, which has an approximate length of 274 feet and an approximate vertical clearance requirement of 105 feet. This vessel makes approximately 11 round trips each year to and from Portage Bay.
- NOAA Fisheries currently has four research vessels that homeport in Seattle. These vessels each transit the Ship Canal up to eight to ten times a year. They range from 93 to 275 feet in length and from 26 to 52 feet in width. Vertical clearances are just over 100 feet.

- Icicle Seafoods currently uses the Ship Canal area. Its largest vessel is approximately 380 feet in length and 70 feet in width. The Northern Victor is the tallest vessel used, with a vertical clearance requirement of 115 feet. This vessel travels through the Ship Canal two to three times a year.
- Foss/General Construction runs a crane derrick on Lake Washington and makes approximately three to four trips per year through the Ship Canal. The derrick is 144 feet to the boom, and 117 feet long. Generally, when the crane is moved, the boom is lowered to 110 feet. With crew on board, the boom can be lowered to approximately 85 feet for moving the crane vessel. As a convenience in operations, the crane is sometimes moved while carrying a load, and the boom is kept at approximately 135 feet during those operations.
- Foss Marine also uses the Ship Canal and runs a ship repair facility located between the Ballard and Fremont Bridges. Large Washington State Ferries vessels access this facility for repairs approximately four times per year during the ferry off-season. The largest is approximately 382 feet in length and 73 feet in width, with an estimated vertical clearance of 70 feet.
- Coastal Transportation is located to the east of the existing Ballard Bridge. Ships leave that area weekly for Alaska, sometimes more frequently. The largest vessel used is 260 feet in length and requires 96 feet of vertical clearance. The 150-foot horizontal clearance is not a difficulty for their operations.
- The Center for Wooden Boats (CWB) in Lake Union conducts an annual Tall Ships Festival. CWB representatives indicated that the Seattle Department of Parks and Recreation has expressed a desire to hold similar wooden boat/tall ship events. The vertical clearance requirements for these vessels vary, but the largest local ship is the Schooner Zodiac (see description below). CWB indicated that a 150-foot horizontal clearance would be more than adequate to meet the needs of these vessels.
- The Schooner Zodiac runs day trips from Lake Union during spring, summer, and fall months. This vessel is 132 feet tall with a full upper mast, but the top mast can be lowered to a height of 101 feet. The vessel typically winters in Lake Union and travels in and out a few times a month during the rest of the year. Its busiest month is July, when it makes multiple day trips in and out along the Ship Canal.
- Manson Construction runs a crane derrick and carries large cranes up to 117 feet in height through the Ship Canal. This vessel uses the Ship Canal anywhere between one and 20 times per year. The cranes are not fixed in height and can be modified to clear the I-90 East Channel Bridge (71 feet of vertical navigational clearance).
- Western Towboat uses the Ship Canal with tugboats. Most of its tugboats do not require the Ballard Bridge to be opened, but some require bridge opening and their largest tug requires approximately 65 feet of vertical clearance. The tugs often tow boats of greater height. Some vessels have folding masts but others do not. The larger vessels towed are approximately 110 feet in height.
- Fremont Tug uses the Ship Canal frequently. The largest vessels used in connection with its operations are approximately 180 to 200 feet in length and require from 60 to 90 feet of vertical clearance. Fremont Tug representatives indicated that the company has no plans for larger vessels at this time.
- Sea Coast Towing uses the Ship Canal. The largest vessel used is approximately 15 feet in length and approximately 50 feet in width. Heights are less than 100 feet.
- The Lake Union Drydock operates a ship repair facility in Lake Union. Work includes Washington State ferries, some military vessels, commercial and pleasure vessels. They have

expressed concerns about bridge heights and stated that they have had to turn away some business in the past because of Aurora Bridge height limits. Recent work included a private yacht over 100 feet in height. The facility does not keep records on height and has been unable to specify particular clients with specific height limit requirements.

- The Seattle Police Harbor Patrol is also a frequent user of the Ship Canal. Currently, the Police Harbor Patrol does not require any drawbridges to be opened for its operations, even the low Fremont Bridge.
- The Seattle Maritime Academy uses two large vessels that are 82 and 100 feet in length, as well as several smaller vessels for training. The vertical clearance required for the largest vessels is approximately 50 feet.
- The Seattle Yacht Club provides moorage for a large number of sailboats and recreational vessels that use the Ship Canal. The largest dimensions of these vessels would be approximately 60 feet in length, 75 feet in height, and 20 feet in width, with most vessels being much smaller.

A number of additional vessels currently require passage through the Ship Canal. These include recreational vessels docked at nearby marinas, such as the Center for Wooden Boats, Seattle Maritime Academy, and Seattle Yacht Club, as well as vessels operated by Fremont Tug, Sea Coast Towing, Seattle Harbor Patrol, and Western Towboat. Specific information on all vessels is not available, but larger vessels with specific navigational requirements are shown above, in the interview and chart forms in Appendix P of the Draft EIS, and in the *Ship Canal and Lake Washington Navigational Study* included in Appendix P of the Draft EIS.

The Muckleshoot Tribe also uses the area in the vicinity of the existing Ballard Bridge for commercial fishing of sockeye, chinook, and coho salmon during the late summer and fall months. The heaviest fishing periods occur between June and February, during which hand-pulled nets and gill nets are frequently placed in the waters near the Ballard Bridge. Ceremonial subsistence fishing (i.e., hook and line) occurs year-round. The entire area is used in the vicinity of all Green Line bridge alternatives. Vessels used by the Muckleshoot Tribe are typically launched from the 14th Avenue NW Boat Ramp on the north bank of the Ship Canal, with sizes ranging from 14 to 23 foot skiffs to 22 to 25 foot long gill netters. During the sockeye salmon run in June-July, up to 50-60 skiffs and 12-25 gill netters typically use the Ship Canal area on a daily basis.

West Seattle Segment

The West Seattle Segment crosses the Duwamish River, which begins at Elliott Bay and extends to the south. South of Elliott Bay, the headwaters of the Duwamish River split into two channels, the East Waterway and the West Waterway. The East Waterway's navigability ends where S Spokane Street crosses the waterway. Vessels cannot travel upstream past the Spokane Street Viaduct on the East Waterway. The West Waterway is impeded by the Spokane Street Bridge, which is a vertical swing bridge that opens on demand for maritime traffic, and by the West Seattle Bridge, which is a fixed-span bridge with 140 feet of vertical clearance.

Vertical navigational clearances for mean high water required by the U. S. Coast Guard for the three bridges crossing the Duwamish River in this segment are listed below:

- Spokane Street Bridge – 55 feet of vertical navigational clearance (this is a swing bridge that opens for ships upon demand, even during rush hour)
- West Seattle Bridge – 140 feet of vertical navigational clearance (this fixed structure does not open)
- Burlington Northern Bridge – eight feet of vertical navigational clearance (this bridge is kept in the open position to allow ships through except during train crossings)

Between 1992 and 2002, the Spokane Street Bridge averaged 2,793 openings per year and 233 openings per month. Table 4.1-6 summarizes the annual and monthly number of Spokane Street Bridge openings that have been recorded between the years 1993 and 2003.

As shown in Table 4.1-6, the number of openings does not dramatically vary between seasons. However, the number of openings is generally slightly lower during the winter months of November, December, January, and February. In May 2003, an average of seven vessels per day required bridge openings with an average duration of 12 minutes. The daily number of openings varied between none and 18 per day, with durations ranging from three to 32 minutes each.

Shorelines along the Duwamish River are lined with industrial and commercial uses. The waterway is an important marine industrial traffic route used extensively for tug and barge travel. Thus, tugboats, barges, and freight boats compose a large portion of vessels using the Duwamish River. The waterway is also used by a large variety of pleasure craft, but the primary users of this waterway are industrial users, including a large number of barge tows.

Table 4.1-6. Spokane Street Bridge Monthly and Annual Bridge Openings (1993 to 2003)

Month	Year											10-Year Average (1993 to 2002)
	1993	1994	1995	1996 ^a	1997	1998	1999	2000	2001 ^b	2002	2003	
January	200	189	240	198	204	177	185	227	211	185	261	202
February	189	186	165	220	191	190	242	239	164	170	223	196
March	176	240	244	230	182	231	304	222	209	198	287	224
April	214	266	248	260	204	198	296	221	180	222	229	231
May	212	252	273	259	256	269	294	218	205	218	229	246
June	253	382	278	254	262	262	324	266	187	248	203	272
July	251	240	250	252	240	268	243	264	185	269	N/A	246
August	267	303	257	283	245	278	199	243	192	237	N/A	250
September	228	272	278	264	236	208	238	258	185	218	N/A	239
October	265	272	225	291	246	235	280	221	192	306	N/A	253
November	205	244	220	219	225	220	213	186	175	360	N/A	227
December	189	254	212	232	196	218	193	162	188	248	N/A	209
Annual Total	2,649	3,100	2,890	2,962	2,687	2,754	3,011	2,727	2,273	2,879	N/A	2,793
Monthly Average	221	258	241	247	224	230	251	227	189	240	239	233

^a Bridge temporarily closed between November 18, 1996 and August 31, 1997.

^b Earthquake on February 28, 2001. Lift turn cylinder cracked on March 19 and replaced on March 22, 2001.

Source: City of Seattle Spokane Street Monthly Bridge Openings Logs, June 2003. This information, as well as 1999-2003 daily Spokane Street Bridge openings logs containing vessel identifications, tonnages, and towages, are incorporated by reference.

The Duwamish River is also used by the Muckleshoot Tribe for steelhead, chinook, coho, and chum salmon fishing during the summer and fall months. In August, during the chinook salmon fishing period, up to 50 skiffs typically use the Duwamish waterway on a daily basis. Most vessels used by the Tribe range from 14 to 23 feet in length and are typically launched from a boat ramp on the east bank of the Duwamish near the SR 99/First Avenue S Bridge. During the peak fishing period, nets are frequently placed in the Duwamish and occasionally extend one-third of the way, or 300 feet across the waterway. The waterway is closed to net fishing between February and June.

4.1.1.6 Air Transportation

The Federal Aviation Authority (FAA) has adopted rules governing navigable airspace and structures that might be obstructions to air navigation (14 CFR Part 77). Under those rules, the FAA has delineated different types of approach surfaces (Part 77 surfaces) extending outward from airports such as King County International Airport (Boeing Field) in Seattle. If a proposed structure extends beyond any of these Part 77 surfaces, a full air navigation analysis may be required by the FAA to determine whether the proposed structure would be an obstruction to air navigation and, if so, what mitigation or modification should be made to the structure. The FAA's Part 77 surfaces for Boeing Field are incorporated into the City of Seattle's Land Use Code in Chapter 23.74 SMC, which includes a map showing the different types of approach surfaces. The FAA's Part 77 surfaces, which extend north past the Magnolia neighborhood and over the Ship Canal, cover the areas where both bridge structures are being proposed by the Green Line project. The West Seattle Bridge area is overlain by both the extended approach surface and by the approach transitional surface. The Ballard Bridge area is overlain by approach transitional surface.

In addition to Boeing Field traffic, the airspace over the Ship Canal corridor is used for some outbound floatplane traffic from the Kenmore Air Harbor floatplane base in south Lake Union. The estimated over flight elevation for Kenmore Air flights in the vicinity of the Ballard Bridge would be at elevations 500 feet above mean sea level (MSL) to 1,000 feet above MSL, depending upon aircraft type.

4.1.2 Impacts

4.1.2.1 Regional and Local Transit Service

The Green Line would improve regional mobility by providing frequent and reliable transit service to many major destinations in the City of Seattle. In addition, the Green Line would result in an improved regional transit network and would result in some shift in system-wide vehicle miles traveled (VMT) from auto to transit. The project's effect on area-wide VMT, its benefits and impacts on local and regional transit service, and projected ridership are discussed in this section.

The project's future benefits to and impacts on both local and regional transit service were also evaluated with respect to:

- Service frequency
- Hours of service
- Reliability (on-time performance and headway adherence)
- Passenger loads
- Travel time
- Transfers
- Service coverage and structure

In general, all of the Green Line alternative alignments would lead to beneficial changes in transit service operations. With the Green Line, there would be improved transit accessibility between residential neighborhoods in Ballard, Uptown, Belltown, Pioneer Square, and West Seattle, and to many of the City's most popular cultural, civic, and transit destinations such as Seattle Center, Westlake Center, Pike Place Market, Pioneer Square, Seahawks Stadium, and Safeco Field. While the rate of transit transfers is anticipated to increase with the Green Line, the transit travel times, total amount of transit service offered, and service reliability would improve.

With the Green Line, it is expected that there will be proposals to truncate or redirect some existing bus routes to serve as feeder routes to Green Line stations. In some cases, rerouting and truncating bus transit routes could cause inconveniences for passengers who would have to transfer between two transit modes to reach their destinations. People with disabilities could be particularly affected. However, SMP's efforts to design the Green Line system to be accessible to all passengers with disabilities, such as providing level-boarding compared to the chair lift system on buses, the close proximity between Green Line stations and bus transit stops, and ADA-compliant pedestrian facilities near each station would minimize any inconvenience to passengers with disabilities resulting from the bus/monorail transfer.

Vehicle Miles Traveled

For the years 2010 and 2020, general shifts in system-wide VMT are anticipated to occur with and without any of the Green Line alternative alignments. The City of Seattle's EMME/2 travel demand forecasting model was used to provide existing and future p.m. peak hour VMT for all Green Line alternatives. The affected area evaluated includes City of Seattle streets west of SR 99 from the north city limit to W Mercer Street, west of I-5 from W Mercer Street to S Michigan Street, and west of SR 99/SR 509 from S Michigan Street to the south city limit. Future No Action VMT was estimated using projected ridership forecasts and assumptions for new transit trips and trip lengths as documented in *Ridership Forecasting Report* (URS Corporation, July 2002).

Total daily VMT with and without the project was also estimated based on this information and by applying a citywide peak hour to daily volume ratio to p.m. peak hour VMT. Table 4.1-7 compares the resulting existing, year 2010, and year 2020 with Green Line and No Action conditions for this performance measure during the p.m. peak hour and for a typical weekday. In both 2010 and 2020, the Green Line alternatives would result in improved conditions compared to the No Action Alternative. The forecasts demonstrate that VMT would be lower with the Green Line alternatives compared to the No Action Alternative.

Table 4.1-7. Year 2010 and 2020 Vehicle Miles Traveled

Time Period	Year 2003 Existing	Year 2010			Year 2020		
		No Action	With Green Line	Change from No Action (%)	No Action	With Green Line	Change from No Action (%)
p.m. Peak Hour	277,700	297,500	292,100	-1.8%	325,900	319,900	-1.8%
Daily	3,409,100	3,643,500	3,604,600	-1.1%	3,978,300	3,935,800	-1.1%

Sources: City of Seattle EMME/2 Model, URS Ridership Forecasting Model, and Parametrix.

Transit Level of Service

A comparative analysis was used to quantify and compare the transit impacts and benefits of any of the Green Line alternative alignments to the No Action Alternative. SMP, Metro, and the City of Seattle would work together to develop proposals to integrate bus and Green Line service, including truncating or redirecting some existing bus routes to serve as feeder routes to Green Line stations. This collaboration is necessary to improve the overall efficiency of transit service along the Green Line corridor.

A transit level of service analysis was conducted to measure the changes between the No Action Alternative and any of the Green Line alternatives. All Green Line alternatives would have similar transit LOS because they serve the same transit rider market; therefore, results shown with the Green Line would apply to any of the alignments and station alternatives. The Transit Capacity and Quality of Service Manual (TCQSM) was used to define the methodology for measuring and comparing transit LOS for the following four transit criteria: service frequency, hours of service, reliability (on-time performance and headway adherence), and passenger loads. For the service frequency, hours of service, and reliability criteria, LOS A is considered ideal and LOS F is considered to be the least desirable. For the passenger load criteria, LOS C or D is considered the most desirable by Metro.

The bus transit routes that were evaluated in this analysis connect Downtown Seattle to either West Seattle or Ballard. Screenlines 1 and 2 were chosen to capture and compare the major bus transit routes serving the Green Line alternative alignments. Screenline 1 crosses the West Seattle Bridge, and Screenline 2 crosses Elliott Avenue W north of W Mercer Place. The information was used to calculate the service frequency, hours of service, and passenger loads. Data for the transit reliability analysis was collected at specific time points. Figure 4.1-1 shows the screenline locations.

The transit analysis was conducted on a weekday during the p.m. peak hour, to establish consistency between analyses and to provide results during the highest peak time period. Metro provided the data for this analysis.

Service Frequency

Service frequency (measured in minutes between trips, also referred to as ‘headway’) determines the number of times per hour that a user has access to the transit service they wish to use. With any of the Green Line alternative alignments, monorail service frequencies are expected to be significantly higher than those on any current single bus route in the Green Line corridor. Local bus service frequencies may increase on selected routes serving Green Line stations; others may remain as they are today with minor adjustments to improve connectivity. The Green Line is proposed to have four-minute headways during the p.m. peak hour. In addition, SMP and Metro have been working together to discuss potential rerouting or truncating some existing bus transit routes that currently serve areas near Green Line stations. Any changes in bus routing would be developed through an extensive community involvement process and with coordination among Metro, the City of Seattle, and SMP. Bus transit service changes would be subject to King County Council approval. The combination of monorail and bus transit service proposed with the Green Line alternatives would provide an overall improvement in the transit service frequency compared to the No Action Alternative.

**Figure 4.1-1
Screenlines 1 and 2
for Transit Analysis**

Alternatives By Segment

Segment 1: Ballard

- 1.1 - West Side of 15th
- 1.1(s) - West Side of 15th with Single Beam
- 1.2 - Center of 15th/East Bridge

Segment 2: Interbay

- 2.1 - West Side of 15th/Center of Elliott
- 2.1(s) - West Side of 15th/Center of Elliott with Single Beam
- 2.2 - Center of 15th/West Side of Elliott

Segment 3: Queen Anne/Seattle Center/Belltown

- 3.1 - Seattle Center/Republican
- 3.2 - Mercer
- 3.3 - Thomas
- 3.5 - Second/Denny

Segment 4: Downtown

- 4.1 - West Side of Second
- 4.2 - East Side of Second with Crossover
- 4.3 - Center of Second
- 4.4 - East Center of Second

Segment 5: SODO

- 5.1 - East side of Third/Utah
- 5.2(s) - West Side of Third/Utah with Single Beam
- 5.2 - West side of Third/Utah

Segment 6: West Seattle

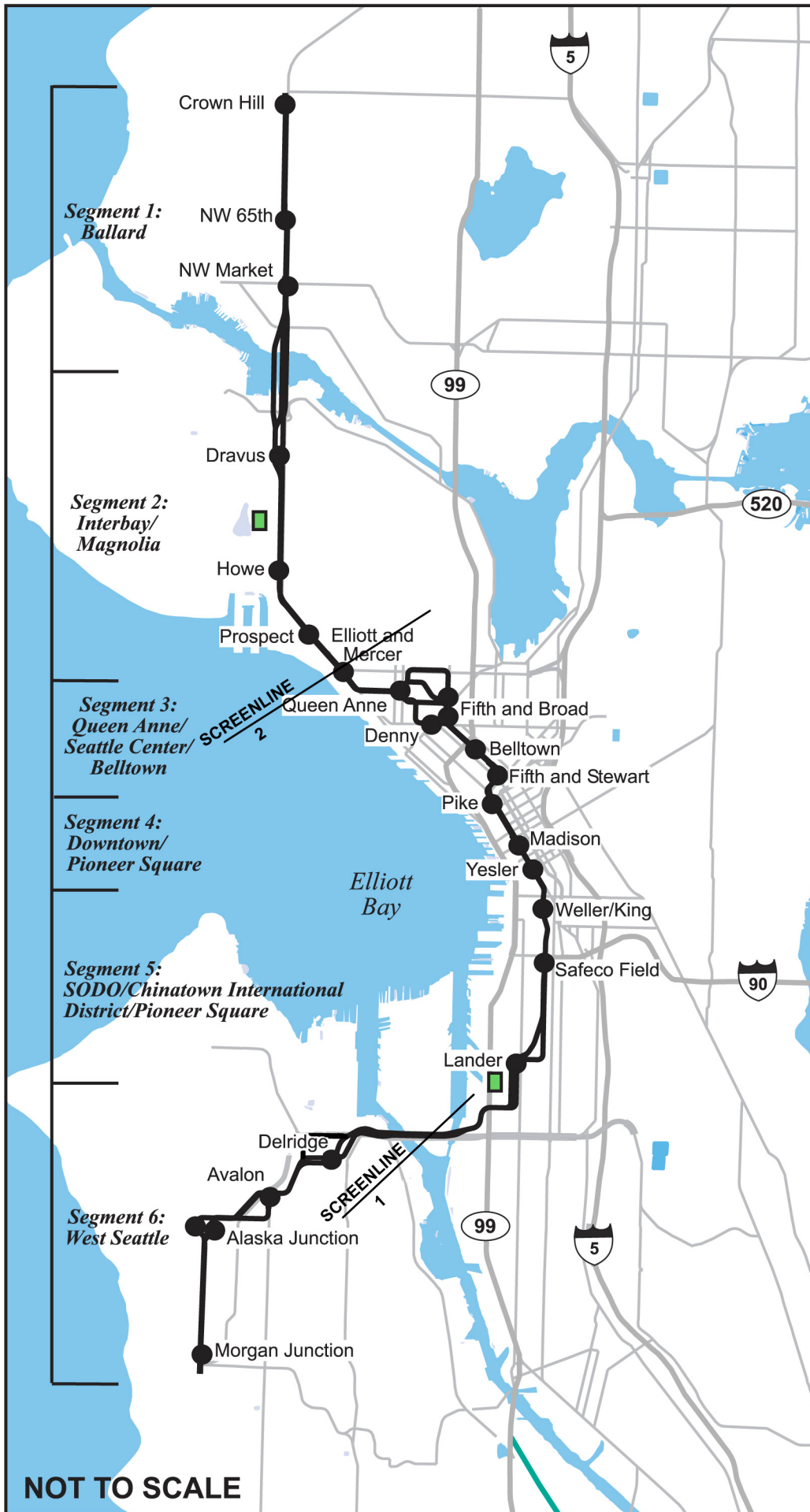
- 6.1 - West Seattle I
- 6.2 - West Seattle II
- 6.3(s) - Delridge North with Single Beam
- 6.4 - West Seattle Andover/Yancy Subsegment
- 6.4(s) - Andover/Yancy with Single Beam
- 6.5 - Genesee Subsegment

Note: Segment Preferred Alternatives are illustrated in Figures 3-32 through 3-36

- Station Vicinities
- Operations Center Alternatives



NOT TO SCALE



The methodology defined in the TCQSM was used to quantitatively compare the average change in transit headways for existing and future bus transit service (No Action), and the future bus transit service with the Green Line. Table 4.1-8 summarizes TCQSM definitions for service frequency LOS, and Table 4.1-9 shows the existing and year 2020 No Action and Green Line Alternatives p.m. peak hour service frequency for Screenlines 1 and 2. As shown in Table 4.1-9, Screenline 1 would operate at LOS C and Screenline 2 would operate at LOS C or better with both the No Action Alternative and Green Line in the year 2020. Overall transit service frequency would improve with the Green Line across both screenlines. The year 2020 No Action service frequency LOS is also an improvement over existing LOS, since Metro's Six-Year Plan includes plans to increase bus service by the year 2020 both with and without Green Line implementation. The average headways presented in this analysis represent the average LOS by transit route, not by rider. Most transit riders would be on routes with more frequent service crossing each screenline; therefore, many riders would experience headways better than the average expressed in the table.

Table 4.1-8. Transit Service Frequency LOS Criteria and Definitions

LOS	Headway (min.)	Comments
A	<10	Passengers don't need schedules
B	10-14	Frequent service, passengers consult schedules
C	15-20	Maximum desirable time to wait if bus/train missed
D	21-30	Service unattractive to choice riders
E	31-60	Transit service is available
F	>60	Service unattractive to all riders

Source: Transit Capacity and Quality of Service Manual, Transportation Research Board (TRB), 2001

Hours of Service

Hours of service, also known as service span, represents the total hours of transit service operations during a weekday. Hours of service were evaluated for bus and any of the Green Line alternative alignments at Screenlines 1 and 2. This measure is important in determining the availability of bus and Green Line transit service provided to potential users. If transit service is not provided at the time a passenger needs to take a trip, the passenger may choose not to use public transportation.

Table 4.1-9. Comparative p.m. Peak Hour Service Frequencies

Screenline Location	Direction	Year 2003		Year 2020 No Action Alternative		Year 2020 Green Line Alternative	
		Average Headway (min.)	LOS	Average Headway (min.)	LOS	Average Headway ¹ (min.)	LOS
1	Both Directions	22.6	D	20.2	C	19.0	C
2	Both Directions	23.0	D	15.2	C	12.3	B

Note 1: The headways reported provide the average headway for the combination of all Green Line and bus transit routes that pass Screenlines 1 and 2.

Bus transit headways vary throughout the day, with the most frequent service generally occurring during the p.m. peak hour. The overall transit hours of service were calculated using weighted average p.m. peak hour headways for all routes crossing each screenline to show the combined transit operation during one of the most frequent times of day. The Green Line is projected to operate 19 hours a day, from 5:00 a.m. to 12:00 a.m., 365 days a year. Peak hours of service with more frequent vehicle headways would be offered weekday mornings from 6:00 to 9:00 a.m. and weekday evenings from 4:00 to 7:00 p.m. Off-peak service with less frequent vehicle headways would be provided at other times of the day. All-day Metro bus routes serving the Green Line corridor have hours of operations that range from 11 to 21 hours per day. Peak-only routes were not figured into the average service spans for either screenline. The hours of service results only show the bus transit routes that cross Screenlines 1 and 2 and may not include the bus routes that only travel within the West Seattle or Interbay/Ballard neighborhoods.

Table 4.1-10 shows TCQSM guidelines for determining transit hours of service LOS. Table 4.1-11 provides a comparison of existing, No Action and Green Line transit hours of service. The bus hours of service would essentially stay the same for the existing conditions and No Action Alternative, where buses would operate late into the evening in West Seattle and Ballard/Interbay.

Table 4.1-10. Transit Hours of Service LOS Criteria and Definitions

LOS	Hours per Day	Comments
A	19-24	Night or owl service provided
B	17-18	Late evening service provided
C	14-16	Early evening service provided
D	12-13	Daytime service provided
E	4-11	Peak hour service/limited midday service
F	0-3	Very limited or no service

Source: Transit Capacity and Quality of Service Manual, 2001

Across Screenlines 1 and 2, the existing year-weighted average hours of service are 16.6 and 19.6 hours, respectively. It is important to note that the results do not suggest that all the routes crossing these screenlines offer late night service. Instead, this suggests late night transit service is available for transit riders crossing either Screenline 1 or 2.

Bus transit hours of operation for the routes that cross Screenline 1 range from six to 21 hours each day for the existing year 2003 and year 2020 No Action Alternative. The hours of service across Screenline 2 varies between 17 and 21 hours per day for the existing year and year 2020 No Action Alternative. With the Green Line, hours of service would improve across Screenline 1 and Screenline 2.

Table 4.1-11. Comparative Total Hours of Service

Screenline Location	Year 2003		Year 2020 No Action Alternative		Year 2020 Green Line Alternatives	
	Average Bus Service Hours per Day	LOS	Average Bus Service Hours per Day	LOS	Average Bus and Monorail Service Hours per Day	LOS
1	16.6	B	16.6	B	17.7	B
2	19.6	A	19.5	A	20.1	A

With the Green Line, many of the bus transit routes traversing the corridor may be truncated or modified to provide feeder service to the Green Line. In addition, many of the bus transit routes that operate for a few hours per day between either West Seattle or Ballard and Downtown Seattle would likely be modified and replaced with the Green Line. This is particularly evident in West Seattle where the Green Line would replace some of the bus transit routes that have short hours of service. Consequently, this would cause the overall transit hours of service across Screenline 1 to improve slightly compared to existing conditions.

Reliability (On-Time Performance and Headway Adherence)

Reliability (on-time performance and headway adherence) is a service measure used to define a passenger's perception of the transit service performance. The on-time performance of any of the Green Line alternatives would be better than existing bus transit routes. Many of the bus transit routes currently use local urban arterial streets and share the general-purpose travel lanes with all other traffic, causing bus transit service to experience similar delays arriving to their destination as motorists.

The Green Line would operate in a separate elevated guideway, which would prevent conflicts with motor vehicles. This would result in better on-time performance than bus riders currently experience. Data from SkyTrain, a heavy rail system in Vancouver B.C. (which itself operates at nearly 95 percent reliability for on-time performance), suggests that Green Line transit reliability would be better than existing bus transit service reliability. Bus transit reliability would improve with the Green Line if bus routes are shortened to serve Green Line stations and no longer need to travel through Downtown Seattle, where they experience the greatest decline in reliability.

Performance reliability was measured using the TCQSM standard reliability LOS methodology. In addition, a qualitative on-time performance evaluation was used to compare existing bus transit routes in the vicinity of the Green Line alternative alignments with the Green Line itself.

Data for bus transit reliability was obtained from Metro's spring 2002 mid-week Automated Passenger Collector (APC) on-time performance database. On-time performance was analyzed for five consecutive weekdays in April 2002, and was based on reliability data along or near the Green Line alternative alignments. The on-time bus transit performance data was provided at specific 'time point' locations at or near some of the Green Line alternative alignments. Existing on-time performance data was used for this analysis, since previous studies conducted by Metro have indicated that on-time performance has not changed significantly over the last 20 years.

Data from SkyTrain was used to estimate the future on-time performance of the Green Line alternatives. SkyTrain and monorail technologies differ; however, they are, for the most part, both elevated systems (SkyTrain is not elevated along its entire length, but does operate within a separated right-of-way) and operate on their own dedicated guideway. Therefore, for the purposes of projecting the future on-time performance of the Green Line, reliability data from SkyTrain was assumed to be a reasonable comparative example. There are differences between SkyTrain and Green Line technologies, including the track switching system, and the structural design; however, these differences would not result in significant on-time performance differences between the two systems. Studies of monorail systems in the United States have shown that the monorail technology is between 99.5 percent and 99.9 percent reliable. Although these systems do not serve similar urban areas as the Green Line, there is the potential that the Green Line could operate with a higher level of on-time performance compared to SkyTrain. British Columbia's Rapid Transit Co Ltd provided SkyTrain reliability data, which represents the on-time performance on a typical weekday. SkyTrain has level-platform boarding for passengers in wheelchairs or with strollers, similar to that proposed for the Green Line. Therefore, any boarding delays associated with passengers in wheelchairs or with strollers are already included in SkyTrain reliability data.

Table 4.1-12 is the LOS description provided by TCQSM, and Table 4.1-13 compares the transit reliability LOS results for existing bus routes and the Green Line. All of the bus transit routes serving the area travel on congested urban arterial streets, where there are delays caused by congestion, accidents, vehicle breakdowns, and other incidents. Transit delays are especially pronounced in Downtown Seattle, during the p.m. peak hour, where outbound traffic volumes are high, the street blocks are short, and a majority of the intersections are signal controlled, with many auto turning movements in the bus lane. All of these issues contribute to the better on-time performance expected in the peak commute direction for any of the Green Line alternative alignments compared to the future No Action Alternative.

Table 4.1-12. Transit Reliability LOS Criteria and Definition

LOS	Coefficient of Variation	Comments
A	0.00-0.10	Passengers experience highly reliable service.
B	0.11-0.20	Service is reliable, but on average, one transit vehicle a week will be late.
C	0.21-0.30	On average, at least one transit vehicle a week will be late.
D	0.31-0.40	Passengers become less assured of arriving on schedule and may choose to take an earlier trip to ensure not being late.
E	0.41-0.50	Passengers take an earlier bus to ensure not being late. Transit bunching occurs occasionally.
F	>0.50	Late trips occur frequently. Transit bunching occurs frequently.

Source: Transit Capacity and Quality of Service Manual, 2001

As shown in Table 4.1-13, bus transit reliability would operate at LOS D or E in the p.m. peak commute direction, away from Downtown Seattle. The Green Line would operate at LOS A, suggesting passengers would experience highly reliable transit service. Rerouting bus transit routes to local neighborhoods, rather than traveling to Downtown Seattle, would most likely improve bus transit reliability for the Green Line alternatives as well.

Table 4.1-13. Comparative p.m. Peak Hour Transit Reliability

Location	Existing Bus Transit Reliability ^{a/b}				Estimated Green Line Reliability ^c	
	Peak		Off-Peak		Peak and Off-Peak	
	Average Coefficient of Variation	LOS	Average Coefficient of Variation	LOS	Average Coefficient of Variation	LOS
NW Market Station	0.33	D	0.27	C	0.05	A
Ballard Avenue NW and NW Market Street	0.39	D	0.23	C	0.05	A
28 th Avenue W and W Blaine Street	0.39	D	0.19	B	0.05	A
Alaska (West Seattle) Junction	0.36	D	0.29	C	0.05	A
Avalon Station	0.43	D	0.29	C	0.05	A
Alaska Junction Station	0.41	E	0.29	C	0.05	A
Morgan Junction	0.38	D	0.27	C	0.05	A

^a On time bus transit reliability was obtained from King County's midweek fall 2001 APC database.

^b The reliability data for bus transit was collected at specific time points along the Green Line alternative alignment. The results show the average coefficient of variation for all the bus transit routes that operate near these time points.

^c Data from the City of Vancouver's SkyTrain was used to estimate the Green Line's reliability during the p.m. peak period, between 4:00 to 6:00 p.m. Data was collected on March 18, 2003, and represents the typical on-time performance on any given day for a SkyTrain station with similar land use characteristics as the Green Line station represented in this table.

Passenger Load

The passenger load analysis reflects a passenger's comfort level for the on-board portion of a transit trip, both in terms of being able to find a seat and in overall crowding levels within the vehicle. In the year 2020, the comfort level on both buses and the Green Line would improve with the implementation of the Green Line. In the future year 2020, both with the No Action and Green Line alternatives, the number of passengers on each route would increase, due to the projected growth in transit riders. The Green Line would accommodate passengers with disabilities, as the Green Line would have platform-level boarding and relatively wide vehicle circulation aisles for wheelchairs and stroller access.

The TCQSM methodology was used to determine passenger load LOS for buses and monorail vehicles. Data for this analysis were obtained from Metro's 2001 p.m. peak average capacity database. From an operational perspective, Metro prefers to operate its buses at passenger load LOS C or D. A bus operating at LOS A, especially in the peak direction during the p.m. peak hour, indicates there are not enough passengers on the bus. At LOS C or D the buses are full, but most passengers are able to find a seat.

Table 4.1-14 summarizes TCQSM definitions for bus and monorail transit passenger comfort levels and Table 4.1-15 summarizes the LOS results for existing passenger loads. For the existing and year 2020 No Action and Green Line alternatives, the passenger load would operate at LOS C or better, in both the peak and off-peak directions. This means passengers would be able to sit on the bus. With any of the Green Line alternative alignments, the passenger loads would improve compared to the No Action Alternative for both bus and Green Line service, with the exception of Screenline 1 in the peak hour direction. The increased passengers per seat at Screenline 1 during the p.m. peak hour indicates the demand to travel to West Seattle on the Green Line would be high.

Table 4.1-14. Transit Passenger Load LOS Criteria and Definitions

LOS	Bus Passengers/Seat	Rail Passengers/Seat	Comments
A	0.00-0.50	0.00-0.50	No passengers need sit next to another
B	0.51-0.75	0.51-0.75	Passengers can choose where to sit
C	0.76-1.00	0.76-1.00	All passengers can sit
D	1.01-1.25	1.01-2.00	Comfortable standee load for design
E	1.26-1.50	2.01-3.00	Maximum schedule load
F	>1.5	>3.00	Crush load

Table 4.1-15. Comparative p.m. Peak Hour Passenger Load LOS

Screenline	Time Period	Year 2002		Year 2020 No Action		Year 2020 Green Line		Year 2020 Green Line	
		Average Bus Passenger/Seat ^{a/b}	LOS	Average Bus Passengers/Seat ^{a/b}	LOS	Average Bus Passengers/Seat ^{a/b}	LOS	Average Green Line Passengers/Seat ^{a/c}	LOS
1	Peak	0.55	B	0.67	B	0.55	B	0.73	B
1	Off-peak	0.26	A	0.31	A	0.16	A	0.20	A
2	Peak	0.68	B	0.82	C	0.75	B	0.63	B
2	Off-peak	0.46	A	0.56	B	0.51	B	0.33	A

^a Approximate value, LOS is based on area per passenger.

^b Bus transit passenger loads are based on the average number of seats per route during the p.m. peak hour. The data was provided by Metro.

^c For the Green Line, the peak system capacity is 3,000 passengers per hour per direction. This includes both standing and seated passengers.

Transit Travel Time

Travel time is one of the most important factors that affect transit ridership. Transit travel time typically includes in-vehicle time, waiting time at stations, and transfer time from one system to another. Total door-to-door travel time would also include:

- Bicycle or walk time to a transit stop or station
- In-vehicle travel time to a transit stop or station
- Bicycle, walk, or vehicle time from transit stop or station to final destination

The overall transit travel time between Downtown Seattle and either West Seattle or Ballard would improve with any of the Green Line alternatives compared to the No Action Alternative. Transit riders with origins and destinations served solely by the Green Line alternative alignments (not requiring transfers between monorail and other travel modes) would have the greatest travel time benefits, due to shorter wait times, no transfer times, and higher in-vehicle speeds. The greatest benefits would occur for the in-vehicle (the actual travel time in either the monorail or bus) portion of the trip, due to the reduced number of stops the Green Line would make compared to bus transit and because the monorail operates in an exclusive guideway above congested streets. In addition, there would be an improvement in the wait time due to more frequent service on the Green Line compared to bus transit.

Transfers

Transit users often perceive transferring between transit vehicles as an impediment. However, it is recognized that the quality and efficiency of transfers, whether between buses or bus and monorail, have a dramatic impact on how transfers are perceived. With any of the Green Line alternatives, the number of transfers per trip is expected to increase. Transfers to and from the Green Line are also expected from other existing and future transit systems such as Washington State Ferries (at Colman Dock), Sounder Commuter Rail, Link Light Rail, Greyhound Buses, Amtrak at King Street Station, and the Waterfront Streetcar.

Factors determining the quality of transfers include wait time, waiting area conditions, and service reliability. Wait time is a function of the service frequency on the route one is transferring to and/or the ability to provide reliable “timed transfer” conditions.

While the number of transfers would be expected to increase with any of the Green Line alternatives, overall travel time and amount of transit service would improve. For passengers transferring from bus to monorail, the wait times would be short, due to the shorter headways associated with the monorail. The current operating plan assumes four-minute peak-period headways in the year 2020. Even during off-peak hours, the Green Line would operate with eight-minute headways. Transfer wait times from the monorail to bus would sometimes be longer than from bus to monorail, particularly when bus frequency is lower than monorail. However, bus route frequencies are expected to generally increase over time and with implementation of the Green Line. Some redeployed hours could be available to increase bus route frequencies. Refer to Appendix OO for the Service Redeployment Guidelines agreed upon by Metro and Sound Transit; a future agreement between Metro and SMP could be similar as mentioned in the letter from Metro included in Appendix EE of this Final EIS.

Service Coverage and Structure

Currently, about 13 bus routes travel between Ballard and Downtown Seattle, and between West Seattle and Downtown Seattle. Some of these routes are through-routed and connect West Seattle with Ballard without a transfer.

Implementation of any of the Green Line alternative alignments would improve the region's public transportation system. More detailed service implementation planning would begin one to two years before actual implementation and would involve a public process led by Metro. The delivery of bus and paratransit service, including any reorganization of service, is subject to service allocation and other guidelines from the Six-Year Transit Development Plan and to yearly-budget authority as approved by the King County Council. Possible service redeployment guidelines to determine the best uses of redeployed transit service to compliment the Green Line system are shown in Appendix OO.

Transit coverage is a measure that can be used to indicate how well households and employment districts are served by transit systems. Implementation of the Green Line would change the structure of public transportation in parts of Seattle. It would provide fast and efficient connections from Downtown Seattle north/northwest to Queen Anne/Seattle Center/Belltown, Interbay/Magnolia, and Ballard, and south/southwest to SODO/Chinatown International District/Pioneer Square and West Seattle with higher capacity, higher speed, higher reliability, and more frequent service. Changes in coverage that would require the use of streets not currently used by transit would require review and approval by the City of Seattle, consistent with the City's street classification process.

Green Line Ridership

Ridership Modeling Assumptions

The Sound Transit ridership forecasting model was used to develop the Green Line system ridership estimates. The origin of this transit model was a bus transit model developed by Metro and Sound Transit. The model is an incremental model that uses socioeconomic data from the PSRC travel demand model, and integrates the regional model with transit ridership forecasting methods. The methodology used is described in detail in *Seattle Popular Transit Plan Ridership Forecast Documentation* (URS Corporation July 2002). The following section summarizes the assumptions used to arrive at the ridership forecasts used for traffic analysis.

The ridership forecasting model includes all transit routes and services throughout the City of Seattle. Transit speed was assumed based on highway speeds. The model assumed that transit modes would not differ substantially in terms of reliability, visibility, comfort, and convenience. Model results were calibrated against information from a 1992 onboard survey, as well as against actual year 1999 trip counts at select screenlines throughout the region. Denny Way and the West Seattle Bridge are two examples of screenlines that were used to validate the model output. Based on the comparisons made, the model was capable of reproducing transit ridership on Denny Way with 98.3 percent accuracy and on the West Seattle Bridge with 96.4 percent accuracy.

To obtain year 2020 forecasts, the calibrated model was used with estimates of work and non-work trips in the future year. In addition, the characteristics of the future transportation system in terms of highway congestion levels and additional transit services determine the additional share of transit trips that would be made in the future.

The ridership forecasts used for traffic analysis also assume the following:

- **Train Frequency/Headways** – The Green Line would operate 19 hours per day, seven days per week on four-minute headways in both directions during peak periods (three hours in both morning and afternoon), and at eight-minute headways during off-peak periods.
- **Train Travel Time** – The Green Line would travel at speeds up to 50 miles per hour, with 20-second stops at stations. A one-way trip along the 14-mile route would take approximately 33 minutes.

- Fares – The nominal fare for the peak period would be \$1.50 and the off-peak fare would be \$1.25. These fares were adjusted to account for monthly pass holders. No ride-free zone would be provided in Downtown Seattle, and a 50 percent transfer rate between bus and monorail was assumed.
- Bus Service – Modest reroutes of existing bus routes would be made to provide feeder bus service to all Green Line stations, and many existing routes between West Seattle and Ballard and Downtown Seattle would be truncated or eliminated to remove duplication when monorail and bus routes would provide overlapping service. These assumptions were developed in coordination with Metro staff. At this stage of Green Line planning and design, commitments for the assumed local transit service changes are not guaranteed. The assumptions used, however, are reasonable and consistent with local bus service changes that have occurred on other rail transit systems in the northwest, such as the Portland Max and Vancouver, B.C. SkyTrain systems. If transit service changes differ from the assumptions used, and less frequent bus service is provided to Green Line Stations, actual Green Line ridership at some stations could decrease.

Model iterations were tested with different headway and fare assumptions, and with a number of alternative alignments and station locations to identify an alternative that would reduce total costs and increase ridership. The assumptions listed above, as well as the current Green Line proposal, are generally consistent with the “Most Promising Route,” as described in *Ridership Forecast Documentation*.

Year 2020 Ridership Forecasts

Daily boardings at the Green Line stations are projected to consist of a combination of typical weekday/commute trips, boardings made by tourists, and ridership generated by special events. Year 2020 weekday/commute trip ridership forecasts were obtained from the ridership forecasting model output documented in the Seattle Popular Transit Plan *Ridership Forecast Documentation*. The “Most Promising Route” presented in the ridership report has characteristics most similar to the Green Line alignment alternatives. Some minor modifications were made to the station-by-station ridership forecasts from this report to reflect recent refinements to the Green Line station alternatives.

Total daily tourist trips and ridership generated by special events were estimated using information provided in *Seattle Monorail Project: Qualitative Estimate of Ridership for Major Events*, prepared by the Transpo Group in March 2002. Daily boardings were distributed to specific stations based on locations of major tourist destinations and major events, with ridership weighted towards the Seattle Center, Weller/King Street, and Safeco Field stations.

Based on information provided in these reports, weekday/commuter trips would result in approximately 69,000 total weekday daily boardings in 2020, comprised of 60,000 to 60,300 daily boardings in the year plus up to 4,000 boardings made by tourists and up to 8,000 daily boardings made by riders on days when special events are being held.

It should be noted that the assumption of 4,000 daily tourist boardings and 8,000 daily special event boardings is consistent with estimates provided in the Seattle Popular Monorail Plan. However, the year 2020 daily ridership estimate of 60,000 to 60,300 average weekday commuter rides is slightly higher but generally consistent with *Ridership Forecast Documentation*, which estimated 59,836 average weekday commuter rides, and the Seattle Popular Monorail Plan, which estimated an average of 57,000 daily weekday commuter rides. The higher estimate was carried forward in subsequent traffic analysis to provide a conservatively high evaluation of potential Green Line impacts on existing infrastructure and other transportation modes. Table 4.1-16 summarizes daily and p.m. peak hour boardings by station.

Table 4.1-16. Year 2020 Green Line Daily Boardings and p.m. Peak Hour Ridership Estimates

Station	Daily Boardings				p.m. Peak Hour Ridership		
	Weekday Non-Tourist/Event ^a	Tourist ^b	Event ^b	Total Daily Boardings	Boarding	Alighting	Total
Crown Hill	3,600	0	300	3,900	195	505	700
NW 65 th	2,600	0	200	2,800	105	245	350
NW Market	3,700	0	300	4,000	270	45	315
Dravus ^d	2,500-2,600	0	175-200	2,675-2,800	70-80	285-295	355-375
Howe/Prospect ^c	500	0	50	550	55	40	95
Elliott and Mercer ^d	1,800-1,900	0	175-200	1,975-2,100	200-215	125	325-340
Seattle Center/Queen Anne	2,200	400	700	3,300	160	270	430
Seattle Center/Fifth and Broad	3,000	600	300	3,900	285	230	515
Belltown	2,200	0	200	2,400	195	95	290
Fifth and Stewart	4,900	1,000	400	6,300	570	280	850
Pike	4,900	1,000	400	6,300	575	280	855
Madison	5,300	300	400	6,000	670	280	950
Yesler	5,000	300	400	5,700	570	310	880
Weller/King	7,200	200	500	7,900	500	525	1025
Safeco Field	1,000	200	2500	3,700	110	430	540
Lander	700	0	100	800	95	10	105
Delridge	2,300	0	200	2,500	110	265	375
Avalon	1,700	0	200	1,900	70	170	240
Alaska Junction	1,800	0	100	1,900	110	155	265
Morgan Junction	3,400	0	400	3,800	115	485	600
TOTAL	60,000-60,300	4,000	8,000	72,000-72,300	5,000-5,030	5,000-5,030	10,000-10,060

^a Numbers shown were estimated based on ridership forecasts for the Most Promising Route, as per URS's Ridership Forecast Documentation, 2002, and total ridership forecasts included in the Seattle Popular Monorail Plan, 2002. Minor adjustments were made to reflect updates to the Green Line station alternatives.

^b Information contained in Seattle Monorail Project: Qualitative Estimate of Ridership for Major Events, prepared by the Transpo Group in 2002, was used as a guideline in estimating daily and peak hour ridership for tourists/events.

^c Daily boardings for the Howe/Prospect station were estimated assuming no new development adjacent to the site would be in place by the year 2020.

^d The high range of daily boardings shown for the Dravus and Elliott and Mercer stations assume that the Howe/Prospect station would not be constructed.

As shown in Table 4.1-16, total daily boardings are generally expected to be the highest at the terminus stations, downtown stations, and at stations, such as the Weller/King station where numerous nearby bus and other transit/rail transfer connections are available. Ridership would also be relatively high at the Seattle Center/Queen Anne and Safeco Field stations on special event days. Since feeder bus connections would be available at all Green Line station locations, the model predicts that 82 percent of the forecasted weekday non-tourist/event ridership would be diverted from future bus transit trips, and that only 18 percent of the forecasted ridership would represent new transit trips (primarily diverted from autos) due to the existence of the Green Line. If bus transit service changes differ from the assumptions used, and less frequent bus service is provided to Green Line Stations, actual Green Line ridership at some stations could decrease. As a result, impacts to station areas would not differ significantly, but could be slightly lower in some cases.

Total ridership at each station was also provided by mode of access in *Ridership Forecast Documentation*. The ridership forecasting model provided results for the following three modes—auto access, walk-on/off (including bicycle trips), and bus/rail transfer. Table 4.1-17 summarizes p.m. peak hour ridership, by final mode of travel, for each station.

In *Ridership Forecast Documentation*, auto access trips were classified separately as park-and-ride and park-and-hide trips, assuming that some parking spaces would be provided at stations. To provide a conservative analysis of traffic impacts, the current analysis assumes that no park-and-ride spaces would be provided and therefore auto access trips would primarily consist of passenger drop-off/pick-up or “drop and drive” trips. The park-and-ride and park-and-hide trips identified in *Ridership Forecast Documentation* were thus combined into the drop and drive category and are shown in Table 4.1-17 under the auto access mode. Some of these trips could still result in vehicles driving to the stations and parking nearby if measures are not taken to restrict this kind of “hide and ride” parking activity. Walk access trips consist of trips that are made exclusively by pedestrians and bicycles to/from their origins/destinations, as well as bus/rail transfer trips requiring some walking distance to access the station. Bus/rail transfer trips shown in the table only represent trips where the transfers occur at the station.

Table 4.1-17. Year 2020 Green Line p.m. Peak Hour Mode of Access/Egress

Station	p.m. Peak Hour Mode of Access			p.m. Peak Hour Mode of Egress			Total Person Trips
	Auto Access	Walk-On	Bus/Rail Transfer	Auto Access	Walk-Off	Bus/Rail Transfer	
Crown Hill	12	55	128	30	142	333	700
NW 65 th	4	80	21	10	187	48	350
NW Market	16	215	39	3	36	7	315
Dravus ^b	3	66	1	11	271	3	355
Howe/Prospect ^a	2	24	29	2	17	21	95
Elliott and Mercer ^b	8	87	105	5	54	66	325
Seattle Center/Queen Anne	3	134	23	5	226	39	430
Seattle Center/Fifth and Broad	6	28	251	5	23	203	515
Belltown	2	186	7	1	91	3	290
Fifth and Stewart	6	462	103	3	227	50	850
Pike	6	280	290	3	136	141	855
Madison	7	294	369	3	123	154	950
Yesler	6	311	253	3	169	138	880
Weller/King	5	108	387	5	114	406	1025
Safeco Field	4	25	81	17	97	316	540
Lander	4	89	2	0	9	0	105
Delridge	7	9	94	16	22	227	375
Avalon	4	11	54	10	28	132	240
Alaska Junction	7	31	73	9	43	103	265
Morgan Junction	7	26	82	29	110	346	600
TOTAL	117	2,521	2,391	171	2,125	2,735	10,060

Note: Developed based on Sound Transit's Link light rail passenger drop-off/pick-up assumptions and URS's Ridership Forecast Documentation. Park & Ride and Park & Hide modes identified in the URS report were combined into the auto access category.

^a Ridership forecasts for the potential Howe/Prospect station were estimated assuming no new development adjacent to the site would be in place by the year 2020.

^b Ridership forecasts for the Dravus and Elliott and Mercer stations would be slightly higher without the Howe/Prospect station.

As shown in Table 4.1-17, the terminus stations would result in the highest number of auto drop-off/pick-up trips. Walk access/egress trips are highest at the downtown stations, as well as at stations near schools, commercial, and residential uses, such as the NW 65th, NW Market, and Dravus stations. Bus/rail transfer activity is high at the Crown Hill, Seattle Center/Fifth and Broad, Downtown Seattle, Weller/King, and most West Seattle stations, due to the provision of restructured bus transit connections to areas beyond a reasonable walking distance to a Green Line station.

4.1.2.2 Local/Station Area Impacts

Localized long-term traffic impacts are measured in terms of year 2010 and 2020 LOS changes at intersections, compared to the No Action Alternative. These impacts could result from changes in traffic volumes related to ingress to and egress from Green Line station areas. Other long-term impacts could result from access, circulation, and roadway modifications required for Green Line operations. Impacts to traffic safety, pedestrian and bicycle connections, and parking, associated with Green Line stations and alignment alternatives are also discussed by segment. Impacts to rail lines, airports, and navigable waterways are also addressed in this section. Potential mitigation measures that would address local traffic and parking impacts on each segment are described.

At this stage of Green Line planning and design, commitments for the assumed local bus transit service changes are not guaranteed. The assumptions used, however, have been endorsed by King County Metro and are reasonable and consistent with local bus service changes that have occurred on other rail transit systems in the northwest, such as the Portland Max and Vancouver, B.C. SkyTrain systems. If bus transit service changes differ from the assumptions used, and less frequent bus service is provided to Green Line Stations, actual Green Line ridership at some stations could decrease. As a result, impacts to station areas identified in this section would not differ significantly, but could be slightly lower in some cases.

Conceptual design drawings, which include plan drawings of the Green Line alignment alternatives and station footprints, and profiles of the bridge alternatives were included in Volume 2, Appendix L, Conceptual Design Drawings for all alternatives evaluated in the Draft EIS. Design information for updated and refined alternatives included in this Final EIS are shown in Appendix LL. These conceptual drawings were used for the evaluation of local/station area impacts. The station footprint drawings include potential locations for vehicle ingress/egress, passenger drop-off activity, potential new bus layover facilities and zones, and bicycle storage racks and lockers. These preliminary design assumptions were developed in close coordination with Metro staff and reflect the needs of the different stations throughout the Green Line corridor (i.e., the need for more bicycle storage, drop-and-drive locations, and bus transfer facilities at non-Downtown Seattle locations). SMP will continue to work with the City of Seattle and Metro throughout the station design process.

Potential improvements to mitigate local/station area impacts are described in Section 4.1.3, Mitigation. These mitigation measures are also described in Chapter 5 of this Final EIS. Appendix CC also provides additional information related to the timing for implementing improvements, identifies the organization that would assume lead implementation responsibility, and notes how the mitigation measure would be monitored.

No Action Alternative Traffic Analysis Assumptions

The City of Seattle's EMME/2 travel forecasting model was used to provide future year 2020 a.m. and p.m. peak hour traffic volume growth rates for the No Action Alternative. The model provided traffic volume forecasts on arterial streets for the year 2020 based on the land use and transportation network assumptions contained in the City of Seattle's Comprehensive Plan and the PSRC's Metropolitan Transportation Plan *Destination 2030*.

Planned Transportation Improvements

To estimate year 2020 travel conditions, assumptions were required for a variety of factors related to future population, employment, and planned transportation facilities. These include the number and geographic distribution of both households and employment in Seattle and the region, characteristics of households and jobs (e.g., number of residents and vehicles per household, household income, etc.), and the transportation network (e.g., streets and transit service).

The year 2020 forecasts for population, households, and employment were based on regional forecasts and allocations of population, households, and employment developed by PSRC. The allocation of regional forecasts to smaller geographic areas for traffic analysis is based on a number of factors, including existing land uses, comprehensive plans, and past trends.

Transportation network (transit and highway) improvements adopted in PSRC's *Destination 2030* served as the basis for developing the 2020 transportation network in the City's model. The following provides a list of some of the major regional transportation projects assumed in the City's 2020 travel demand forecasts:

- Link Light Rail Transit (LRT) – Seattle Central Business District (CBD) to Seattle-Tacoma International Airport; Seattle CBD to University District.
- SR 520 Corridor Improvements (add HOV lane on SR 520 bridge span and extend to I-5)
- Two-way HOV lanes on I-90
- SR 509 extension to I-5
- I-405 Corridor Improvements (four general purpose lanes on I-405)

Traffic Volume Forecasts

Existing (year 2000 to 2003) turning movement count information for all existing study area intersections were used as a starting point for developing year 2020 p.m. peak hour turning movement volumes. Annual compounded traffic volume growth rates were developed for each segment along the Green Line alternative alignments using 1998 and 2020 traffic volume data obtained from the City of Seattle's EMME/2 model. These annual compounded growth rates, shown in Table 4.1-18, are consistent with projected traffic increases along the City's traffic volume screenline locations identified in the Comprehensive Plan for the neighborhoods affected by the Green Line and are generally consistent with growth rates experienced throughout the City of Seattle in recent years. As shown in Table 4.1-18, growth rates are expected to be the highest in the Ballard, Queen Anne/Seattle Center/Belltown, and West Seattle neighborhoods. Even in these neighborhoods, however, the growth rates shown do not indicate that substantial growth is expected in the next 20 years.

Table 4.1-18. Annual Traffic Growth Rates - By Segment

Segment	Annual Compounded Growth Rate	
	a.m. Peak Hour	p.m. Peak Hour
Segment 1 – Ballard	0.54%	0.88%
Segment 2 – Interbay/Magnolia	0.28%	0.47%
Segment 3 - Queen Anne/Seattle Center/Belltown	0.86%	0.93%
Segment 4 - Downtown/Pioneer Square	0.20%	0.59%
Segment 5 – SODO/Chinatown ID/Pioneer Square	0.45%	0.55%
Segment 6 - West Seattle	1.00%	1.02%

Source: City of Seattle EMME/2 Forecasts, 2003.

Green Line Alternative Traffic Analysis Assumptions and Methodology

Vehicle trips generated by the Green Line were calculated separately for each station alternative, and added to the projected year 2010 and 2020 No Action Alternative p.m. peak hour turning movement volumes to develop traffic volumes for the year 2010 and 2020 Green Line Alternatives. Trip generation was calculated based on the p.m. peak hour mode-of-access ridership forecasts for each station (shown in Table 4.1-17), and p.m. peak hour bus service levels provided by King County. New vehicle trips generated by the Green Line alternative stations were assumed to consist of drop-and-drive trips to and from the stations, staff trips, and net increases in bus volumes over No Action Alternative conditions. Trip generation forecasts for each station alternative are summarized in Table 4.1-19. Note that this analysis did not assume any decrease in traffic volumes due to the potential displacement of some trip-generating uses (such as convenience stores) from Green Line station locations and did not assume any overall decline in auto travel due to the presence of the Green Line, even though studies indicate that regional vehicle-miles-traveled would decrease after the Green Line begins operations.

Table 4.1-19. Year 2020 Green Line p.m. Peak Hour Trip Generation Summary

Station Alternative	Motor Vehicle Trips To/From Station Alternatives – by Type			
	Drop and Drive Trips	Staff Trips	New Bus Trips ^b	Total Motor Vehicle Trips (Round Trips)
Crown Hill 1, 1A, and 2	42	4	4	50
NW 65 th 1, 1A, 1B, and 2	14	4	3	21
NW Market 1,2, 3, and 3A	19	4	7	30
Dravus 1, 1A, and 1B ^a	15	4	4	23
Dravus 2 ^a	15	4	8	27
Howe 1, 1A, and 2	4	4	11	19
Prospect 3	4	4	-4	4
Elliott and Mercer 1, 1A, and 2 ^a	13	4	-12	5
Seattle Center/Queen Anne 1, 1A, and 2	8	0	0	8
Seattle Center/Fifth and Broad 1, 1A and 2, Denny 3	11	4	0	15
Belltown 1, 1A, 2, and 3	3	0	0	3
Fifth and Stewart 1, 1A, 2, 2A, and 3	9	0	0	9
Pike 1, 2, 2A, and 3	9	0	-3	6
Madison 1, 2, 2A, and 3	10	0	-3	7
Yesler 1 and 2	9	0	-3	6
Weller/King 1 and 2	10	0	0	10
Safeco Field 1	21	0	0	21
Lander 1, 2, 3, and 4	4	4	4	12
Delridge 1, 1A, 2, 3, and 4	23	4	14	41
Avalon 1 and 3	14	4	11	29
Avalon 2A and 2B	14	4	4	22
Alaska Junction 1 and 1A	16	4	14	34

Table 4.1-19. Year 2020 Green Line p.m. Peak Hour Trip Generation Summary (continued)

Station Alternative	Motor Vehicle Trips To/From Station Alternatives – by Type			Total Motor Vehicle Trips (Round Trips)
	Drop and Drive Trips	Staff Trips	New Bus Trips ^b	
Alaska Junction 2	16	4	10	30
Morgan Junction 1, 1A, and 2	36	4	3	43

Note: Developed based on information from URS's Ridership Forecast Documentation, King County Metro bus service assumptions, and SMP preliminary station design drawings.

^a To provide for a conservatively high trip generation estimate, drop-and-drive trips for these stations were estimated assuming that the future potential Howe/Prospect station would not be constructed.

^b Bus volume increases and decreases are also caused by some transit routes being redirected to provide improved service to Green Line stations. The volume increases/decreases shown are estimates based on a representative "example" bus network provided by Metro. Traffic volumes on adjacent streets were adjusted (i.e. on-street traffic increase or decrease) based on these preliminary service and routing assumptions.

The year 2020 p.m. peak hour vehicle trips estimated to be generated at each station alternative, as shown in Table 4.1-19, were assigned to study area roadways and intersections based on existing travel patterns, station access, and preliminary bus routing assumptions provided by Metro for each station. These new trips generated by auto access to and from the stations were added to the year 2020 No Action traffic volumes to estimate year 2020 traffic volumes for the Green Line alignment alternatives. To present a conservative evaluation of potential traffic impacts, no credit was taken for any reduction in vehicle miles traveled (VMT) resulting from the Green Line, as shown in Table 4.1-7. To provide for a conservatively high analysis of potential impacts, the year 2020 p.m. peak hour vehicle trip generation was also used to evaluate year 2010 traffic conditions resulting from the project.

Since background and project volumes are generally higher during the p.m. peak hour, analysis of traffic impacts during the a.m. peak hour was limited to selected intersection locations where traffic operations could potentially be worse during the a.m. peak hour than during the p.m. peak hour. These include areas where traffic volumes would be higher during the a.m. peak hour than the p.m. peak hour, where roadway capacity restrictions are currently in place during the a.m. peak hour, or where Green Line alignment alternatives would significantly reconfigure the right-of-way to accommodate its permanent infrastructure.

Level of Service and Congestion

The Synchro version 5.0 model was used to determine LOS at signalized and unsignalized intersections. The LOS at signalized intersections is defined in terms of average delay per vehicle, based on the definitions described in the *2000 Highway Capacity Manual*. These definitions are shown in Table 4.1-1 of the Affected Environment section. In most cases, the signal timing plans provided by the City of Seattle were used for the analysis of future No Action and Green Line Alternatives. Where appropriate, minor changes were made to existing signal timing/phasing plans to model future No Action conditions. To compare the relative impacts of the Green Line on future traffic conditions, no changes were made to future No Action signal timing/phasing assumptions to evaluate conditions with the Green Line alternatives.

In this section, the analysis assumes certain street cross-sections (lane widths, sidewalk widths, etc.) after construction of the Green Line guideway and stations. These cross-section assumptions have been reviewed and discussed with the City of Seattle, which has authority to determine street cross-sections. The cross-sections represent what SMP believes to be a reasonably conservative assumption of project impacts (see Volume 2, Appendix LL, Design Drawings for Street Cross Sections). Where existing traffic lanes are narrower than the City's standards for new streets, it has generally been assumed that those existing traffic lanes would remain in the existing general configuration or widths, because the

proposed Green Line is not the cause of that existing configuration. Generally, if lanes were re-stripped to the standards for new streets, the result could be a loss of traffic lanes or sidewalk width. A large variety of street cross-section configurations are possible, including configurations that would widen existing lane widths.

Pedestrian and Bicycle Facilities Analysis

Pedestrian LOS was analyzed using the methodology from the Highway Capacity Manual 2000 (HCM), and the TCQSM. The analysis was conducted at all signalized intersections within one block or 300 feet of each station. These sidewalks would have the highest concentration of pedestrians boarding and alighting the Green Line during the p.m. peak hour. For analysis purposes, it was assumed that a five-foot minimum effective sidewalk width, as required by the City of Seattle for arterial streets, would be provided on all of these sidewalks for both existing and future conditions. This effective width, or clear walkway width, excludes unused space (i.e., near curbs, buildings, and other physical obstructions such as light poles, mail boxes, and parking meters). This analysis was used to determine whether the five-foot minimum effective sidewalk width would accommodate pedestrian demand generated by the Green Line.

With regard to pedestrian and bicycle access at stations, SMP is in the process of working with communities, neighborhood groups, and businesses to develop station designs that provide safe and convenient access for pedestrians and bicycles to the stations from bus transit stops, key neighborhood activities, and residential areas. As part of the station access and design process, SMP will also be considering ADA requirements, safety and comfort of users, and aesthetics/urban design to create an inviting and welcome environment. Conceptual station footprints used for this EIS analysis are included in Volume 2, Appendix LL, Conceptual Design Drawings.

Ballard Segment

For traffic analysis purposes, Alternative 1.1 (West Side of 15th) and 1.1(s) (West Side of 15th with single beam) would remove the southbound and northbound off-peak parking/peak travel lanes on 15th Avenue NW due to the placement of the guideway on the west side of the street. The analysis further assumed that northbound right turn only lanes would be retained on 15th Avenue NW at NW 85th Street, NW 80th Street, and NW 65th Street, and that on-street parking could be provided on the east side of the street and between guideway columns on the west side of the street. Based on preliminary design assumptions, all roadway cross sections associated with Alternative 1.1 and 1.1(s) would provide lane widths, sidewalk, and parking areas that are consistent with existing conditions.

Alternative 1.2 (Center of 15th) would place the guideway in the existing two-way left-turn lane in the center of 15th Avenue NW. The Alternative 1.2 traffic analysis assumed that left turns would be prohibited to and from unsignalized side streets and driveways, and that left turn movements would be retained at the following signalized locations on 15th Avenue NW: NW 85th Street, NW 80th Street, NW 75th Street, NW 70th Street, NW 67th Street, NW 65th Street, NW 60th Street, and NW 58th Street. The analysis also assumed that new signals would be provided and left turns allowed at the NW 83rd Street and NW 63rd Street intersections. The existing southbound and northbound off-peak parking/peak travel lanes would be displaced to accommodate left turns at these signalized intersections. With Alternative 1.2, the 15th Avenue NW cross-section provides lane widths, sidewalks, and parking areas that are consistent with existing conditions.

Traffic Volumes and Level of Service

The Synchro version 5.0 model was used to determine LOS at signalized and unsignalized intersections. The level of service at signalized intersections is defined in terms of average delay per vehicle, based on the definitions described in the *2000 Highway Capacity Manual*. These definitions are shown in Table 4.1-1 of the Affected Environment section. In most cases, the signal timing plans provided by the City of Seattle were used for the analysis of future No Action and Green Line alternatives. Where appropriate,

minor changes were made to existing signal timing/phasing plans to model future No Action conditions. To compare the relative impacts of the Green Line on future traffic conditions, no changes were made to future No Action signal timing/phasing assumptions to compare conditions with the Green Line alternatives.

Table 4.1-20 summarizes the LOS evaluation results for weekday p.m. peak hour conditions in years 2010 and 2020 with No Action and the Green Line. Under Green Line alignment Alternative 1.1 and 1.1(s), two different station alternatives were evaluated for the Market Street station area (Market 1 and Market 3) and the LOS results representing the highest delay of the two station alternatives are listed in Table 4.1-20.

As shown in Table 4.1-20, No Action conditions would be incrementally worse than existing conditions, which is to be expected without system improvements and with an overall increase in traffic volumes. Most locations would operate at LOS E or better conditions for both the No Action and Green Line Alternatives; therefore, mitigation evaluations have not been conducted for 2010 conditions. Exceptions include the 15th Avenue NW/NW 85th Street, 15th Avenue NW/NW 80th Street, and 15th Avenue NW/NW Market Street intersections, which would operate at LOS F during the p.m. peak hour in the year 2010 due to reductions in northbound through and/or right turn capacity associated with Alternative 1.2.

In the year 2020, most intersections in the Crown Hill station area would operate at LOS E or better during the p.m. peak hour with the No Action and Green Line alternatives. At the 15th Avenue NW/NW 85th Street intersection, the southbound left-turn movement opposes the high volume northbound through movement in the p.m. peak hour; due to coordination needs of the northbound through movement with adjacent signals, the southbound left-turn movement would experience delays greater than the intersection average with all alternatives. As a result, the 15th Avenue NW/NW 85th Street intersection would operate at LOS F with the No Action and Green Line alternatives. With Alternative 1.1, average vehicle delays would increase by 3.1 seconds over the No Action Alternative. With Alternative 1.2, the LOS F condition is further affected and average delay would increase by an additional 32.3 seconds due to the reduction in northbound right turn capacity. The 15th Avenue NW/NW 80th Street intersection would operate at LOS F during the p.m. peak hour with both Alternatives 1.1 and 1.2, due to a reduction in northbound through capacity.

**Table 4.1-20. Ballard Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Nearest Station	Intersection	Year 2010				Year 2020		
		Existing	No Action	Alt.		No Action	Alt.	
				1.1/1.1(s)	Alt. 1.2		1.1/1.1(s)	Alt. 1.2
Crown Hill	NW 85 th Street/ Eighth Avenue NW	C (31.2)	D (35.6)	D (36.0)	D (35.8)	D (45.1)	D (48.8)	D (48.5)
	NW 85 th Street/ 24 th Avenue NW	B (11.9)	B (12.3)	B (12.7)	B (12.7)	B (15.1)	B (15.8)	B (15.8)
	15 th Avenue NW/ Holman Road NW ^a	C (22.9)	D (26.7)	D (28.0)	D (28.0)	D (33.6)	E (35.7)	E (35.7)
	15 th Avenue NW/ NW 85 th Street	D (47.9)	E (66.5)	E (67.2)	F (99.4)	F (87.1)	F (90.2)	F (122.5)
	15 th Avenue NW/ NW 80 th Street	C (31.2)	D (42.3)	E (68.4)	F (80.4)	E (61.3)	F (90.7)	F (104.9)
	15 th Avenue NW/ NW 75 th Street	A (3.3)	A (3.8)	A (8.1)	A (8.4)	A (4.1)	A (9.9)	B (10.3)
NW 65 th	NW 65 th Street/ Eighth Avenue NW	C (24.8)	C (24.8)	C (24.8)	C (24.8)	C (31.5)	C (31.9)	C (31.9)
	NW 65 th Street/ 20 th Avenue NW	A (8.8)	A (9.1)	A (9.1)	A (9.1)	A (9.7)	A (10.0)	A (10.0)

**Table 4.1-20. Ballard Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives (continued)**

Nearest Station	Intersection	Existing	Year 2010			Year 2020		
			No Action	Alt. 1.1/1.1(s)	Alt. 1.2	No Action	Alt. 1.1/1.1(s)	Alt. 1.2
NW 65 th (cont'd)	15 th Avenue NW/ NW 70 th Street	A (9.2)	A (7.2)	B (11.4)	B (12.6)	A (8.1)	C (21.1)	C (21.3)
	15 th Avenue NW/ NW 67 th Street	A (5.4)	B (12.0)	B (12.0)	A (6.9)	A (9.7)	A (9.7)	A (9.9)
	15 th Avenue NW/ NW 65 th Street	D (42.4)	E (55.2)	E (55.5) ^b	E (56.3)	E (73.4)	E (72.0) ^b	E (76.2)
	15 th Avenue NW/ NW 60 th Street	A (2.1)	A (3.3)	A (3.4)	A (3.4)	A (3.6)	A (3.7)	A (3.7)
NW Market	NW Market Street/ 14 th Avenue NW	B (16.4)	B (16.7)	B (16.7) ^c	B (16.7)	B (17.2)	B (17.3) ^c	B (17.3)
	NW Market Street/ 17 th Avenue NW	B (13.9)	B (13.8)	B (13.9) ^b	B (13.8)	B (14.4)	B (14.4)	B (14.4)
	NW Market Street/ 20 th Avenue NW	B (16.5)	B (16.9)	B (16.9) ^b	B (16.9)	B (17.0)	B (16.9) ^b	B (16.9)
	15 th Avenue NW/ NW 58 th Street	A (5.1)	A (6.4)	A (7.4) ^c	A (7.0)	A (8.2)	A (9.2) ^c	A (9.2)
	15 th Avenue NW/ NW Market Street	E (59.7)	E (72.7)	E (75.1) ^c	F (104.3)	F (93.9)	F (95.8) ^c	F (128.4)
	15 th Avenue NW/ NW Leary Way (NB ramps)	C (23.6)	C (25.6)	C (25.6)	C (25.6)	C (29.4)	C (29.5)	C (29.5)
	15 th Avenue NW/ NW Leary Way (SB ramps)	B (10.1)	B (11.4)	B (11.4)	B (11.4)	B (12.7)	B (13.0)	B (13.0)

Source: Parametrix, 2003.

Notes: Analysis was conducted using Synchro 5.0 software and 2000 Highway Capacity Manual. All results shown are with the highest ridership alternative. Alternative 1.1(s) would be the same as Alternative 1.1 for this analysis.

() Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line alternatives, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand.

^a Unsignalized stop controlled intersection. Results shown are for the eastbound approach.

^b Results shown are with NW Market 1 station alternative. NW Market 3/3A results in slightly better intersection operations.

^c Results shown are with NW Market 3/3A station alternatives. NW Market 1 results in slightly better intersection operations. Intersection LOS estimates for the Preferred Alternative are noted above in bold type.

In the NW Market station area, one intersection (15th Avenue NW/NW Market Street) would operate at LOS F during the p.m. peak hour with the No Action and Green Line alternatives. Average delays at this intersection are expected to increase by less than five seconds per vehicle from the No Action to Green Line Alternative 1.1 or 1.1(s), but would increase by more than 30 seconds per vehicle with Green Line Alternative 1.2. The northbound through/right turn movement would require the most green time at this intersection with Alternative 1.2 due to the elimination of the northbound right turn only lane. The remaining study intersections are projected to operate at LOS E or better with either the No Action or Green Line alternatives. In general, higher delays would be expected with Alternative 1.2 than with Alternative 1.1 or 1.1(s). Therefore, the overall intersection operations would be better with Alternative 1.1 or 1.1(s). While some of the moderate difference in delays can be attributed to these additional turning movements, the primary cause of the delay increases with Alternative 1.2 is the reduction in northbound through and/or right turn capacity.

Table 4.1-21 summarizes all of the alignment Alternative 1.1 and 1.1(s) LOS evaluation results for intersections nearest to the Market station. Alignment Alternative 1.1 and 1.1(s) were evaluated for two different Market station alternatives and Table 4.1-21 compares the two station alternatives. Alignment Alternative 1.2 was evaluated using one site option and those results are presented in Table 4.1-20; therefore, information has not been repeated in Table 4.1-21. As shown in Table 4.1-21, the different station alternatives considered for NW Market are projected to result in minor differences in intersection delay. However, the impacts described above for the years 2010 and 2020 generally apply to all station alternatives being considered.

**Table 4.1-21. Ballard Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternative 1.1/1.1(s) Market Station Alternatives**

Nearest Station	Intersection	Existing	No Action	Year 2010		No Action	Year 2020	
				NW Market 1	NW Market 3/3A		NW Market 1	NW Market 3/3A
NW Market	NW Market Street/ 14 th Avenue NW	B (16.4)	B (16.7)	B (16.7)	B (16.7)	B (17.2)	B (17.3)	B (17.3)
	NW Market Street/ 17 th Avenue NW	B (13.9)	B (13.8)	B (13.9)	B (13.7)	B (14.4)	B (14.4)	B (14.3)
	NW Market Street/ 20 th Avenue NW	B (16.5)	B (16.9)	B (16.9)	B (16.8)	B (17.0)	B (16.9)	B (16.9)
	15 th Avenue NW/ NW 58 th Street	A (5.1)	A (6.4)	A (6.4)	A (7.4)	A (8.2)	A (8.4)	A (9.2)
	15 th Avenue NW/ NW Market Street	E (59.7)	E (72.7)	E (74.2)	E (75.1)	F (93.9)	F (95.2)	F (95.8)
	15 th Avenue NW/ NW Leary Way (NB ramps)	C (23.6)	C (25.6)	C (25.6)	C (25.6)	C (29.4)	C (29.5)	C (29.5)
	15 th Avenue NW/ NW Leary Way (SB ramps)	B (10.1)	B (11.4)	B (11.4)	B (11.4)	B (12.7)	B (13.0)	B (13.0)

Source: Parametrix, 2003.

Notes: Analysis was conducted using Synchro 5.0 software and 2000 Highway Capacity Manual. All results shown are with the highest ridership alternative.

() Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line alternatives, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand.

Intersection LOS estimates for the Preferred Alternative are noted above in bold type.

Table 4.1-22 summarizes the a.m. peak hour analysis updated from existing conditions for future conditions with the alignment alternatives.

**Table 4.1-22. Ballard Segment: a.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Nearest Station	Intersection	Existing	Year 2010			Year 2020		
			No Action	Alt. 1.1/1.1(s)	Alt. 1.2	No Action	Alt. 1.1/1.1(s)	Alt. 1.2
Crown Hill	15 th Avenue NW/ Holman Road NW ^a	F (>180.0)	F (>180.0)	F (>180.0)	F (>180.0)	F (>180.0)	F (>180.0)	F (>180.0)
	15 th Avenue NW/ NW 85 th Street	C (40.1)	D (47.5)	D (48.2)	D (51.9)	E (55.4)	E (57.7)	E (62.9)
NW 65 th	15 th Avenue NW/ NW 65 th Street	C (24.2)	D (42.5)	D (45.3)	D (42.9)	D (54.2)	E (55.8)	E (53.7)
NW Market	15 th Avenue NW/ NW Market Street	D (35.6)	D (38.9)	E (55.1)^b	E (67.4)	D (43.2)	E (62.7)^b	E (79.3)

Source: Parametrix, 2003.

Notes: Analysis was conducted using Synchro 5.0 software and 2000 Highway Capacity Manual. All results shown are with the highest ridership alternative. For purposes of this analysis, Alternative 1.1(s) would have the same impacts as Alternative 1.1.

() Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line alternatives, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand.

^a Unsignalized stop controlled intersection. Results shown are for the eastbound approach.

^b Results shown are with the NW Market 3/3A station alternatives. NW Market 1 results in slightly different intersection operations.

Intersection LOS estimates for the Preferred Alternative are noted above in bold type.

With additional traffic in the future and no infrastructure improvements, the eastbound approach of the 15th Avenue NW/Holman Road NW intersection could continue to operate at LOS F conditions with increased delays for the No Action and Green Line alternatives during the a.m. peak hour. There is no discernable LOS difference between Green Line Alternatives 1.1 or 1.1(s) and 1.2 at this location, and delays could increase with the Green Line alternatives when compared to the No Action Alternative. All other study intersections are projected to operate at LOS E or better conditions with either Alternative 1.1/1.1(s) or 1.2.

The Market station alternatives 1, 3, and 3A under Alignment Alternative 1.1 or 1.1(s) are projected to result in an a.m. peak hour delay difference at the 15th Avenue NW/NW Market Street intersection of less than two seconds per vehicle in both the year 2010 and 2020. In 2010, the intersection could operate at LOS E with a delay of 56.2 seconds per vehicle with station alternative 1 and 55.1 seconds per vehicle with station alternatives 3 or 3A. In 2020, the intersection could operate at LOS E with a delay of 64.3 seconds per vehicle with station alternative 1 and 62.7 seconds per vehicle with station alternatives 3 or 3A.

Access and Circulation

Property access impacts in the Ballard Segment would differ for each alignment alternative depending on the location of the Green Line guideway within the 15th Avenue NW right-of-way. Alternative 1.2 would result in greater impacts to access and circulation than Alternative 1.1 or 1.1(s), due to the placement of Green Line guideway columns in the existing two-way left-turn lane along 15th Avenue NW. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis.

With Alternative 1.1 and Alternative 1.1(s), columns would be placed on the west side of 15th Avenue NW, in the west travel/off-peak parking lane between NW 85th Street and NW 65th Street, and on the sidewalk and planter area between NW 65th Street and the Ballard Bridge. By reconfiguring or relocating existing sidewalk and planter areas, the analysis assumed that all existing effective sidewalk widths could be maintained and/or widened to accommodate pedestrian volumes to and from the Green Line. Placement of these columns would be designed to minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Alternative 1.2 would place guideway columns in the existing two-way left-turn lane in the center of 15th Avenue NW. The analysis assumed that existing effective sidewalk widths could be maintained with this alternative. Property access impacts are expected in the form of reduced left-turn opportunities. Existing full-access driveways and unsignalized intersections would likely be restricted to right-in, right-out access only to accommodate the guideway columns in the center of 15th Avenue NW. The vehicular access restrictions caused by the placement of guideway columns in the center two-way left-turn lane is not expected to significantly increase travel times during p.m. peak hour conditions, since the existing high northbound and southbound p.m. peak hour volumes on 15th Avenue NW currently make it difficult for vehicles to turn left into and out of unsignalized driveways and side streets. During off-peak conditions, the left-turn restrictions could result in some out-of-direction travel for motorists to reach their destinations. The analysis assumed that new signalized intersections with left turn channelization and pedestrian crosswalks could be provided at NW 83rd Street and NW 53rd Street, which would reduce the potential for these impacts.

Traffic Safety

The primary traffic safety impacts in the Ballard Segment would be caused by the introduction of guideway columns in the public right-of-way. Alternative 1.2 would likely result in greater traffic safety impacts than Alternative 1.1 or 1.1(s), since guideway columns would be placed in the existing two-way left-turn lane in the center of 15th Avenue NW.

With Alternative 1.1 or 1.1(s), columns would be placed in the west travel/off-peak parking lane, sidewalk, or planter area on the west side of 15th Avenue NW so as to not impede vehicular or pedestrian travel and to provide adequate sight distance around the columns.

With Alternative 1.2, the introduction of guideway columns in the center of 15th Avenue NW could result in a reduction in midblock accidents due to the elimination of left-turn movements at unsignalized intersections and driveways. Prohibiting these mid-block left turns would virtually eliminate the potential for midblock left-turn and right-angle vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents. On the other hand, left-turn restrictions at unsignalized intersections could lead to increased traffic due to out-of-direction travel on parallel arterial or local access streets. The analysis assumed that new signalized intersections with left turn channelization and pedestrian crosswalks could be provided at NW 83rd Street and NW 53rd Street, which would reduce the potential for these impacts. The Green Line alignment alternatives would result in increases in vehicular, transit, bicycle, and pedestrian activity in the vicinity of the stations. These stations would be designed to provide safe and convenient access for all travel modes.

Pedestrian and Bicycle Facility Impacts

The land uses within the Ballard Segment, which are a mix of commercial, recreational, residential, and four public schools, generate some pedestrian activity in the area. There are continuous sidewalks on most east-west arterial streets leading to the three station alternatives. However, a sidewalk is currently missing on one side of NW 85th Street between 15th Avenue NW and 18th Avenue NW. There are sidewalks on all of the north-south arterials in the study area. Crosswalks and curb ramps currently exist at all of the signalized intersections within the Ballard area. Table 4.1-23 summarizes the number of pedestrian trips expected at each station.

Table 4.1-23. Ballard Segment: Nonmotorized Facility Impact Summary

Station Name and Alternative	2020 P.M. Peak Hour Walk Trips	
	Ingress	Egress
Crown Hill 1, 1A, and 2	55	142
NW 65 th 1, 1A, 1B, and 2	80	187
NW Market 1, 2, 3, and 3A	215	36

Based on the pedestrian LOS analysis, all sidewalks evaluated within one block or 300 feet of Green Line stations currently operate at LOS A, which suggests pedestrians can walk freely along the sidewalks with little or no conflicts with other pedestrians. All of the sidewalks in the study area would continue to operate at LOS A in the years 2010 and 2020 for the No Action and all Green Line alignment and station alternatives. Some surges in pedestrian traffic would result from bus arrivals near Green Line stations in the Ballard Segment. Even with these surges, sidewalks near these stations would operate acceptably at LOS B or better in the years 2010 and 2020.

A number of bicycle facilities currently exist within a ½-mile radius of all station alternatives in the Ballard Segment. On-street bicycle lanes exist along Eighth Avenue NW from north of 85th Avenue NW to NW Market Street and along Greenwood Avenue N to Phinney Avenue N. In addition, NW 77th Street serves as an east-west bicycle route near the Crown Hill station alternatives.

The amount of bicycle storage recommended to be provided at each station was determined based on projected bicycle demand near each station. Each station alternative was categorized as generating low (250 square feet), medium (500 square feet), or high (1,000 square feet) bicycle demand, based on adjacent land use patterns, monorail ridership/mode-of-access forecasts, and proximity to existing bicycle routes. This methodology is generally consistent with PSRC's *Bikestation Demand Methodology*. Table 4.1-24 summarizes the bicycle storage facilities proposed for each Green Line station in the Ballard Segment. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. The higher figures represented in the table represent a longer-term space allocation, demonstrating how space could be provided for higher numbers of bicycles if demand increases.

Table 4.1-24. Ballard Segment: Proposed Bicycle Facilities

Station Name and Alternative	Proposed Bicycle Parking Area ^a	Bicycle Storage ^b (Number of Bicycles)
Crown Hill 1, 1A, and 2	1,000 square feet	48
NW 65 th 1, 1A, 1B, and 2	1,000 square feet	48
NW Market 1, 2, 3, and 3A	500 square feet	24

^a Space allocation includes areas for future expansion.

^b The number of bicycles accommodated assumes covered racks. The amount of parking provided at project opening may be less than shown.

Parking Impacts

Parking Supply

Green Line Alternatives 1.1, 1.1(s), and 1.2 in the Ballard Segment would result in a net loss of 48 to 313 parking spaces. These include a combination of on-street parking losses due to layover zones at stations, on- and off-street parking losses due to the Green Line alignment and column placement, and off-street parking losses due to partial property takes for station facilities. These losses to existing parking supply are summarized by alignment alternative in Table 4.1-25. Table 4.1-26 summarizes the parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS. The parking losses shown in Table 4.1-26 for each station alternative are accounted for in the total parking losses summarized in Table 4.1-25.

As shown in Table 4.1-25, Alternative 1.2 (East Bridge) is anticipated to result in a higher net parking loss than Alternatives 1.1.1 and 1.1.2 (West and Far West Bridge). Alternatives 1.1.1 and 1.1.2 are expected to displace some existing on-street (off-peak) parking spaces on the west side of 15th Avenue NW due to column placement and re-sign the remaining parking between columns as all-day parking spaces. With Alternatives 1.1.1 and 1.1.2, the analysis assumes that 45 new all-day parking spaces could also be provided between columns on the west side of 15th Avenue NW between NW 65th Street and NW 51st Street.

Table 4.1-25. Ballard Segment: Total Parking Losses – By Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement or Switching Area		Parking Losses at Station Alternatives ^c		Potential New All-Day On-Street Parking Spaces ^b	Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street		
1.1 – West Side of 15 th	65	7 to 17	21 to 61	0 to 18	45	48 to 116
1.1.1 – West Bridge	65	7	21 to 61	0 to 18	45	48 to 106
1.1.2 – Far West Bridge	65	17	21 to 61	0 to 18	45	58 to 116
1.1(s) – Single Beam	65	19	15	0	45	54
1.2 – East Bridge/Center of 15 ^{th d}	0 to 171	8	84	60	10	142 to 313

^a Parking impacts shown are permanent displacements due to Green Line guideway column placement, bus zones, drop-and-drive areas, and partial property takes associated with different alignment and station alternatives.

^b New on-street parking spaces could be added between Green Line guideway columns in some locations where parking does not already exist.

^c See Table 4.1-26 for a detailed breakdown of these potential parking losses.

^d The low range of parking losses shown assumes that no left turns would be provided at signalized or unsignalized intersections along 15th Avenue NW due to column placement in the existing center two-way left-turn lane. The high range reflects the additional parking losses that could result if left turn channelization is provided at the following signalized intersections on 15th Avenue NW: NW 85th Street, NW 83rd Street, NW 80th Street, NW 75th Street, NW 70th Street, NW 67th Street, NW 65th Street, NW 63rd Street, NW 60th Street, and NW 58th Street. Impacts for the Preferred Alternative are noted above in bold type.

Table 4.1-26. Ballard Segment: Parking Losses at Station Alternatives^a

Station	Spaces Displaced	Area Affected by Displacement
Crown Hill 1 (Alternative 1.1)	3	15 th Avenue NW (3 spaces) ^b
Crown Hill 1A (Alternative 1.1 or 1.1(s))	3	15th Avenue NW (3 spaces)^b
Crown Hill 2 (Alternative 1.2)	58	15 th Avenue NW (18 spaces) ^b , Safeway Parking Lot (40 spaces)
NW 65 th 1 and 1A (Alternative 1.1)	9	15 th Avenue NW (9 spaces) ^b
NW 65th 1B (Alternative 1.1(s))	3	15th Avenue NW (3 spaces)^b
NW 65 th 2 (Alternative 1.2)	17	15 th Avenue NW (17 spaces) ^b
NW Market 1 (Alternative 1.1)	67	15 th Avenue NW (3 spaces) ^b , 14 th Avenue NW (up to 46 spaces) ^b , Walgreens Parking Lot (18 spaces)
NW Market 2 (Alternative 1.2)	69	15 th Avenue NW (3 spaces) ^b , 14 th Avenue NW (up to 46 spaces) ^b , Walgreens Parking Lot (10 spaces), Safeway Parking Lot (10 spaces)
NW Market 3 (Alternative 1.1)	9	15 th Avenue NW (9 spaces) ^b
NW Market 3A (Alternative 1.1(s))	9	15th Avenue NW (9 spaces)^b
Switching Areas (Alternative 1.1(s))^c	10	Off-street parking at First Mutual Bank (5 spaces) and Carter Used Cars (5 spaces)

^a Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. Parking losses identified for private properties do not represent losses of all available on-site parking.

^b Required for bus layover, active bus stops, and/or drop-and-drive zones.

^c Parking underneath proposed switch locations has been assumed to be fully displaced. This is a conservatively high estimate of parking impacts for these areas since some parking spaces under switches could be maintained. Impacts for the Preferred Alternative are noted above in bold type.

Alternative 1.2 would not displace any on-street parking spaces along 15th Avenue NW due to column placement in the existing center two-way left-turn lane, if no left turn channelization is provided. However, if left turn channelization is provided, up to 171 on-street parking spaces could be displaced from both the west and east sides of 15th Avenue NW. With Alternative 1.2, the analysis assumes that 10 new all-day parking spaces could be provided on the east side of 15th Avenue NW between NW 52nd and NW 53rd Streets. For Alternative 1.1(s), off-street parking losses on private property due to column placement could be slightly higher with the Far West Bridge (Alternative 1.1.2) than with the West Bridge (Alternative 1.1.1).

As shown in Table 4.1-26, the station alternatives associated with Alternative 1.2 (Crown Hill 2, NW 65th 2, and NW Market 2) provide station platforms in the center of 15th Avenue W and would generally result in higher parking losses than would the station options associated with Alternative 1.1 or 1.1(s) (Crown Hill 1 and 1A; NW 65th 1, 1A, and 1B; NW Market 1, 3, and 3A). On-street parking losses associated with the station options are primarily associated with layover facilities, or designated drop-and-drive zones. Off-street parking displacements for partial property takes are also expected for the Crown Hill 2, NW Market 1, and NW Market 2 stations.

The parking losses shown in Tables 4.1-25 and 4.1-26 would not result in significant impacts to existing parking supply, since a total of 3,718 existing on-street unrestricted parking spaces are currently provided within ¼-mile radius of the station locations.

Parking Demand

On-street unrestricted parking near the Ballard Segment stations is currently 42 to 65 percent used during the early morning hours and 35 to 64 percent used during mid-day hours (Refer to Appendix OO of this Final EIS, Transportation Backup Information, for a more detailed discussion of existing parking supply and demand within ¼-mile radius of each Green Line station alternative). Based on these relatively low utilization rates and a relatively high parking supply, there is some potential for hide-and-ride parking impacts, particularly by Green Line passengers traveling from areas north, west, and east of the Green Line alternatives. As shown in Table 4.1-17, approximately 42 passengers at the Crown Hill Station, 14 passengers at the NW 65th Station, and 19 passengers at the NW Market Station were assumed to access the Green Line via drop-and-drive during the p.m. peak hour in the year 2020. If on-street unrestricted parking continues to be available near these stations, some of these auto trips may choose to hide-and-ride near the Green Line stations. This potential hide-and-ride parking demand could be accommodated by on-street unrestricted parking within ¼-mile radius of Green Line stations if parking management programs are not implemented. The potential for hide-and-ride parking impacts is particularly high near the Crown Hill station, due to its location at the Green Line's northern terminus. Mitigation measures to address potential hide-and-ride impacts are discussed in Chapter 5.

Truck Circulation

In the Ballard Segment, Alternatives 1.1, 1.1(s), and 1.2 are located on 15th Avenue NW, which is currently classified as a T-2 truck route (320 to 800 large trucks per day). Most trucks using this route would travel through the Ballard Segment and would not be affected by either of the alignment alternatives, as roadway widths and turning radii required for truck movement through this corridor would be maintained. However, some local truck circulation impacts may result from Alternative 1.2 due to the addition of guideway columns in the center of 15th Avenue NW. A more detailed discussion of each alternative follows.

Alternative 1.1 and 1.1(s) would locate guideway columns in the west travel/off-peak parking lane between NW 85th street and NW 65th Street, and on the sidewalk and planter area between NW 65th Street

and the Ballard Bridge. Placement of these columns would not preclude left or right turning movements to and from adjacent businesses and side streets. No truck circulation impacts would be expected if columns are located to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks.

Alternative 1.2, which would place guideway columns in the existing two-way left-turn lane in the center of 15th Avenue NW, could restrict full-access driveways and unsignalized intersections to right-in, right-out access only. Left turns could be restricted to signalized intersections. Travel time increases and delays for trucks are anticipated as a result of the left-turn restrictions, since some trucks would be diverted to other non-residential arterial roadways to reach their destinations. The analysis assumed that new signalized intersections with left turn channelization could be provided at NW 83rd Street and NW 53rd Street, which could reduce the potential for these impacts.

Preferred Alternative

In the Ballard Segment, Alternative 1.1(s), the single beam configuration along the west side of 15th Avenue NW, with the Crown Hill 1A, NW 65th 1B, and NW Market 3A Station Alternatives, and the West Bridge (Alternative 1.1.1) is the Preferred Alternative. The west side alignment was selected as the Preferred Alternative to make left-turn access into businesses easier, minimize disruptions to traffic flow, and retain more on-street parking than a center alignment. The single beam configuration was selected to minimize the Green Line's impacts and complement the neighborhood context.

Guideway columns would be placed on the west side of 15th Avenue NW, in the southbound off-peak parking/peak travel lane between NW 85th Street and NW 65th Street, and on the sidewalk and planter area between NW 65th Street and the Ballard Bridge. The existing southbound and northbound off-peak parking/peak travel lanes would be removed between NW 85th and NW 65th Streets to match the five-lane section north and south of there.

Tables 4.1-20 and 4.1-21 summarize the results of the p.m. peak hour level of service (LOS) analysis conducted for Alternative 1.1(s). As shown in these tables, all study area intersections would operate at LOS E or better in the year 2010 with the Preferred Alternative. In the year 2020, the 15th Avenue NW/NW 85th Street and 15th Avenue NW/NW Market Street intersections would operate at LOS F with the No Action and Preferred Alternatives; delay increases associated with the Green Line would be minimal (less than five seconds compared to the No Action Alternative). The 15th Avenue NW/NW 80th Street intersection would also operate at LOS F in the year 2020 with the Preferred Alternative, due to a reduction in northbound through capacity. Mitigation measures to address these impacts are discussed in Chapter 5. Table 4.1-22 summarizes the results of the a.m. peak hour LOS analysis. As shown in Table 4.1-22, most intersections evaluated would operate at LOS E or better during the a.m. peak hour in the years 2010 and 2020 with the Preferred Alternative. The only exception is the unsignalized 15th Avenue NW/Holman Road NW intersection, which would operate at LOS F with the No Action and Preferred Alternatives. Overall, the Preferred Alternative would result in a slight worsening of LOS over the No Action Alternative, but would result in fewer LOS impacts than Alternative 1.2.

With regard to access and circulation, safety, and potential truck circulation impacts, placement of Green Line guideway columns on the west side of 15th Avenue NW would be located to minimize impacts to left or right turning movements to adjacent businesses. Columns could be located to avoid impeding vehicular, pedestrian, and truck circulation at side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns. By reconfiguring or relocating existing sidewalk and planter areas, the analysis assumed that all existing effective sidewalk widths could be maintained and/or widened to accommodate pedestrian volumes to and from the Green Line. Fifteenth Avenue NW is currently classified as a T-2 truck route (320 to 800 large trucks per day) and major truck street in the

City of Seattle's Comprehensive Plan. Most trucks using this route would travel through the Ballard Segment and would not be affected by either of the alignment alternatives, as roadway widths and turning radii required for truck movement through this corridor would be maintained. Overall, the Preferred Alternative would result in fewer access and circulation, safety, and truck circulation impacts than Alternative 1.2.

Table 4.1-23 summarizes the number of pedestrian trips expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B or better in the years 2010 and 2020 with the Preferred Alternative. In addition, a number of bicycle facilities currently exist within 1/2-mile radius of all stations associated with the Preferred Alternative. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at the Crown Hill Station, and 20 bicycle spaces at the NW 65th and NW Market Stations. Table 4.1-24 summarizes the longer-term space allocation proposed for bicycle storage at each Green Line station if bicycle demand increases. A net loss of approximately 54 parking spaces (35 on-street, 19 off-street) is expected to result from the Preferred Alternative. A breakdown of these losses is shown in Tables 4.1-25 and 4.1-26 for Alternative 1.1(s). As shown in these tables, approximately 65 on-street parking spaces would be displaced due to column placement along the west side of 15th Avenue NW between NW 85th Street and NW Market Street; approximately nine off-street parking spaces on private property would also be displaced due to column placement. These losses would be partially offset by a gain of approximately 45 new on-street parking spaces between guideway columns on 15th Avenue NW between NW 65th Street and the Ballard Bridge. Drop-and-drive zones along 15th Avenue NW would displace approximately three parking spaces near the Crown Hill 1A Station, three parking spaces near the NW 65th 1B Station, and nine on-street parking spaces near the NW Market 3A Station. Switching areas associated with the Preferred Alternative could also result in a loss of up to 10 additional spaces in the Ballard Segment. These parking losses would not result in significant impacts to existing parking supply, since a total of 3,718 existing on-street unrestricted parking spaces are currently provided within 1/4-mile radius of the station locations. There is some potential for hide-and-ride parking impacts in the Ballard Segment, particularly near the Crown Hill Station, due to its location at the northern Green Line terminus. However the available on-street unrestricted parking supply at this station and all other stations in the Ballard Segment far exceeds the potential hide-and-ride parking demand if parking management programs are not implemented. Mitigation measures to address parking at stations are described in Chapter 5. Overall, the Preferred Alternative would result in fewer parking losses than Alternatives 1.1.2 and 1.2, and similar parking losses as Alternative 1.1.

Interbay/Magnolia Segment

For traffic analysis purposes, Alternative 2.1 (West Side of 15th/ Center of Elliott) and 2.1(s) (West Side of 15th/Center of Elliott with single beam) were assumed to remove a southbound parking/peak travel lane on 15th Avenue W south of W Dravus Street with the Green Line guideway located on the west side of the street. Along Elliott Avenue W, placement of the guideway columns in the center two-way left-turn lane would restrict left turns to and from unsignalized driveways and intersections. Traffic analysis was conducted assuming that a new signal could be provided at W Lee Street; and that southbound left and U-turn movements would be added at this intersection. Left-turn movements would be retained at the following signalized intersections: W Garfield Street, Galer Street flyover, W Prospect Street, W Mercer Place, and W Mercer Street. In addition, U-turns would be permitted for passenger vehicles at the Galer Street flyover (southbound only), W Prospect Street, W Mercer Place, and W Mercer Street (southbound only) signalized intersections to minimize the impact of these left-turn prohibitions. The southbound and northbound off-peak parking/peak travel lanes would be displaced to accommodate left and U-turns at these signalized intersections. The analysis further assumed that on-street parking could be provided between columns on the west side of 15th Avenue W.

Alternative 2.2 would place the guideway in the existing two-way left-turn lane in the center of 15th Avenue W. The traffic analysis for this alternative conservatively assumed that left turns to and from unsignalized driveways and intersections on 15th Avenue W would be prohibited, and that left-turn opportunities would be retained at the signalized intersections at Gilman Drive W and W Armour Way. The analysis also assumed that a new signal would be provided at W Armour Street. Left turn and U-turn movements would be provided for passenger vehicles at all three of these signalized intersections. Along Elliott Avenue W, the analysis assumed that the southbound off-peak parking/peak travel lane would be displaced due to the placement of the guideway on the west side of the street and that new all-day parking would be provided. With Alternative 2.2, the assumed cross-section for 15th Avenue W would meet City design standards. Along Elliott Avenue W, the lane widths assumed in the traffic analysis are consistent with existing conditions.

Traffic Volumes and Level of Service

Table 4.1-27 summarizes the No Action and Green Line p.m. peak hour LOS analysis results for the years 2010 and 2020 for all major signalized intersections affected by Green Line alternatives and station areas in the Interbay/Magnolia Segment. It should be noted that two different station alternatives were evaluated for the Howe/Prospect station under Alignment Alternative 2.2 and the LOS results representing the highest delay of the two station alternatives are listed in Table 4.1-27.

As shown in Table 4.1-27, the year 2010 analysis indicates that most intersections in the project area would operate at acceptable LOS E or better during the p.m. peak hour with the No Action and Green Line Alternatives. The intersections that would operate at LOS F include:

- W Dravus Street/16th Avenue W
- 15th Avenue W/W Armour Street
- 15th Avenue W/W Wheeler Street

Table 4.1-27. Interbay/Magnolia Segment: Year 2010 and 2020 p.m. Peak Hour Level of Service Comparison

Nearest Station	Intersection	Existing	Year 2010			Year 2020		
			No Action	Alt. 2.1	Alt. 2.2	No Action	Alt. 2.1	Alt. 2.2
Dravus	W Dravus Street/20 th Avenue W	B (11.6)	B (12.0)	B (12.2)	B (12.2)	B (12.9)	B (13.1)	B (13.1)
	W Dravus Street/16 th Avenue W	F (67.1)	F (110.8)	F (131.6)^a	F (>180.0)	F (137.1)	F (166.6)^a	F (>180.0)
	15 th Avenue W/W Dravus Street (NB Ramps)	D (32.2)	E (39.7)	E (41.2)	E (40.8)	E (49.2)	F (51.0)	F (50.5)
	15 th Avenue W/W Dravus Street (SB Ramps)	D (32.9)	E (40.1)	E (41.9)	E (41.9)	E (49.2)	F (51.4)	F (51.4)
	15 th Avenue W/W Armour Street	F (>180.0)	F (>180.0)	F (>180.0)	A (2.3) ^{b,d}	F (>180.0)	F (>180.0)	A (2.4) ^{c,d}
	15 th Avenue W/Gilman Drive W	B (11.0)	B (14.9)	B (14.6)	B (17.8)	B (16.6)	B (16.8)	C (20.4)
	15 th Avenue W/W Wheeler Street	F (>180.0)	F (>180.0)	F (>180.0)	C (15.3)	F (>180.0)	F (>180.0)	C (17.8) ^c
Howe/Prospect	15 th Avenue W/W Armour Way	A (3.1)	A (3.5)	A (3.2)	A (3.6)	A (3.8)	A (3.5)	A (4.0) ^c
	15 th Avenue W/W Garfield Street	A (7.6)	A (8.3)	A (4.9)	A (8.4) ^b	A (8.6)	A (4.5)	A (8.8) ^b
	Elliott Avenue W/W Galer Street	B (15.8)	B (16.9)	— ^e	B (17.0)	B (19.3)	— ^e	B (19.4) ^c
	Elliott Avenue W/ W Galer Street Flyover	B (15.6)	B (13.3)	B (13.6)	B (13.7) ^b	B (19.0)	B (19.5)	B (19.6) ^b
	Elliott Avenue W/ W Prospect Street	A (1.2)	A (2.5)	B (11.0)	A (2.5) ^c	A (2.8)	B (14.6)	A (2.8) ^c

Table 4.1-27. Interbay/Magnolia Segment: Year 2010 and 2020 p.m. Peak Hour Level of Service Comparison (continued)

Nearest Station	Intersection	Existing	Year 2010			Year 2020		
			No Action	Alt. 2.1	Alt. 2.2	No Action	Alt. 2.1	Alt. 2.2
Elliott/Mercer	Elliott Avenue W/W Mercer Place	B (19.3)	C (22.4)	F (98.1)	C (23.0) ^c	C (28.3)	F (107.8)	C (28.9) ^c
	Elliott Avenue W/W Mercer Street	A (0.1)	B (12.5)	B (14.9)	B (15.3) ^c	B (13.3)	B (15.5)	B (15.9) ^c
	Elliott Avenue W/ W Harrison Street	B (10.8)	B (12.0)	B (11.7)	B (11.6)	B (12.8)	B (12.5)	B (12.5) ^c
	Elliott Avenue W/ Western Avenue W	A (6.1)	A (6.4)	A (6.4)	A (6.4)	A (7.4)	A (7.2)	A (7.2)

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand. Additionally, unsignalized intersections with delays in excess of 180.0 seconds (3 minutes) per vehicle have been marked as (>180.0). For purposes of this analysis, impacts for Alternative 2.1(s) are the same as for Alternative 2.1.

^a Results shown are with Dravus 1B station site. Dravus 1 and 1A would operate with an average vehicle delay of 111.0 seconds per vehicle in the year 2010 and 138.7 seconds per vehicle in the year 2020.

^b Results shown are with Howe 2 station site. Prospect 3 station site operates slightly better.

^c Results shown are with Prospect 3 station site. Howe 2 station site operates slightly better.

^d Analysis of Alternative 2.2 assumed that the 15th Avenue W/W Armour Street intersection would be signalized to provide protected northbound and southbound left and U-turns.

^e Analysis of Alternative 2.1 assumed that the existing signal at the Elliott Avenue W/W Galer Street intersection would be removed and left turns restricted.

Intersection LOS estimates for the Preferred Alternative are noted above in bold type.

All of these intersections are stop-sign controlled and are located near the Dravus station. In the year 2020, three more intersections would be added to the list of LOS F intersections. Two of these intersections, also located near the Dravus station, are the northbound and southbound 15th Avenue W ramp terminal intersections at W Dravus Street. LOS at both intersections for either Alternative 2.1 or 2.2 would be LOS F in the year 2020; however, the average vehicle delay increase between the No Action and Green Line Alternatives is less than 3.0 seconds. The Elliott Avenue W/W Mercer Place intersection would also operate at LOS F in the year 2020 with Alternative 2.1.

At the W Dravus Street/16th Avenue W intersection, Alternative 2.1 or 2.1(s) would result in minimal increases in delay whereas Alternative 2.2 could result in considerable increases in delay at the W Dravus Street/16th Avenue W intersection. The movements on the southbound approach would experience the greatest delays of all of the approaches at the intersection.

The 15th Avenue W/Armour Street and 15th Avenue W/Wheeler Street intersections would require mitigation with Alternative 2.1 or 2.1(s) due to increased delays at side street approaches. Alternative 2.2 includes modifications at these intersections as part of its design that would reduce delays at the intersections. The LOS A condition reported for 15th Avenue W/Armour Street is due to the assumption that a signal would be installed at this intersection with Alternative 2.2.

At the 15th Avenue W ramp intersections with Dravus Street, the increase in delays between the No Action and Green Line Alternatives are minimal and due to the limitations of the Highway Capacity Manual methodology for evaluating all-way stop control operations, as discussed in the Affected Environment section. The eastbound right-turn lane was removed for analysis purposes at the southbound ramps intersection, which results in an overestimation of the delay expected at the intersection.

The Elliott Avenue W/W Mercer Place intersection would operate at LOS F in the year 2020 with Alternative 2.1/2.1(s) compared to LOS C with the No Action Alternative. This change in intersection LOS is primarily due to the removal of a northbound and southbound a.m. and p.m. peak travel lane.

Table 4.1-28 summarizes all of the Alternative 2.2 LOS evaluation results for intersections near the Howe/Prospect station alternatives. Either the Howe 2 or Prospect 3 station alternatives could be considered with alignment Alternative 2.2. LOS and delay results for these two station alternatives differ slightly and are summarized in Table 4.1-28.

Table 4.1-28. Interbay/Magnolia Segment Alternative 2.2 Howe/Prospect Station Alternatives: Year 2010 and 2020 p.m. Peak Hour Level of Service Comparison

Nearest Station	Intersection	Year 2010				Year 2020		
		Existing	No Action	Howe 2 Station	Prospect 3 Station	No Action	Howe 2 Station	Prospect 3 Station
Howe/ Prospect	15 th Avenue W/ W Armory Way	A (3.1)	A (3.5)	A (3.6)	A (3.6)	A (3.8)	A (3.8)	A (4.0)
	15 th Avenue W/ W Garfield Street	A (7.6)	A (8.3)	A (8.4)	A (8.3)	A (8.6)	A (8.8)	A (8.5)
	Elliott Avenue W/ W Galer Street	B (15.8)	B (16.9)	B (17.0)	B (17.0)	B (19.3)	B (19.3)	B (19.4)
	Elliott Avenue W/ W Galer Street Flyover	B (15.6)	B (13.3)	B (13.7)	B (13.2)	B (19.0)	B (19.6)	B (18.8)
	Elliott Avenue W/ W Prospect Street	A (1.2)	A (2.5)	A (2.4)	A (2.5)	A (2.8)	A (2.7)	A (2.8)

Source: Parametrix, 2003.

Notes: Analysis was conducted using Synchro 5.0 software and 2000 Highway Capacity Manual. All results shown are with the highest ridership alternative.

() Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand. Additionally, unsignalized intersections with delays in excess of 180.0 seconds (3 minutes) per vehicle have been marked as (>180.0).

As shown in Table 4.1-28, the different station alternatives considered for at Howe/Prospect result in minor differences in intersection delay when considered for the same alignment. The impacts described above for the alignment alternatives in years 2010 and 2020 apply to all station alternatives being considered.

Table 4.1-29 summarizes the a.m. peak hour LOS analysis results for selected intersections in the Interbay Segment. The study intersections for the a.m. peak hour would operate at LOS E or better conditions. The Howe/Prospect assumptions under Alternative 2.2 result in a difference in a.m. peak hour delay at the 15th Avenue W/W Garfield Street intersection of less than one second of delay per vehicle in both year 2010 and year 2020. Other intersection delays near the station would not differ under Alternative 2.2. In 2010, the intersection would operate at LOS A with a delay of 3.9 seconds per vehicle with Howe 2 and 3.7 seconds per vehicle with Prospect 3 due to the different station locations under Alternative 2.2. In the year 2020, the intersection would operate at LOS A with a delay of 3.9 seconds per vehicle with Howe 1 and 3.8 seconds per vehicle with Prospect 3. The most pronounced change in operations would occur at the Elliott Avenue W/W Mercer Place intersection due to the removal of the southbound a.m. peak travel lane with any of the Green Line alternatives. The resulting reduction in southbound capacity on Elliott Avenue W would be the primary cause of this change in operating conditions.

Table 4.1-29. Interbay/Magnolia Segment: Year 2010 and 2020 a.m. Peak Hour Level of Service Comparison

Nearest Station	Intersection	Year 2010				Year 2020		
		Existing	No Action	Alt. 2.1	Alt. 2.2	No Action	Alt. 2.1	Alt. 2.2
Dravus	15 th Avenue W/ W Dravus Street (NB Ramps)	C (25.8)	C (27.5)	C (28.2)	C (29.2)	C (28.1)	C (28.5)	C (29.4)
	15 th Avenue W/ W Dravus Street (SB Ramps)	C (26.3)	C (27.5)	C (28.0)	C (28.6)	C (29.3)	C (29.7)	C (30.2)
Howe/Prospect	15 th Avenue W/ W Garfield Street	A (3.3)	A (3.7)	A (3.9)	A (3.9) ^a	A (3.8)	A (3.9)	A (3.9) ^a
Elliott/Mercer	Elliott Avenue W/ W Mercer Place	A (9.4)	B (10.9)	E (60.2)	D (52.3)	B (11.2)	E (66.8)	E (58.1)

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle. In some cases, average delays decrease with the Green Line, despite overall increase in traffic volumes. This occasionally occurs when increases in traffic volume are made to movements with unused green-time available to accommodate additional demand. Additionally, unsignalized intersections with delays in excess of 180.0 seconds (3 minutes) per vehicle have been marked as (>180.0). For purposes of this analysis, Alternative 2.1(s) would have the same results as Alternative 2.1.

^a Results shown are with the Howe 2 station site. The Prospect 3 station site operates slightly better. Intersection LOS estimates for the Preferred Alternative are noted above in bold type.

Access and Circulation

Property access impacts in the Interbay/Magnolia Segment differ for each alternative, depending on the location of the guideway within the 15th Avenue W and Elliott Avenue W rights-of-way. Overall, Alternative 2.1 or 2.1(s), which would place guideway columns on the west side of 15th Avenue W and in the median of Elliott Avenue W, would likely result in greater impacts to access and circulation than Alternative 2.2, which would place the guideway columns in the center left-turn lane of 15th Avenue W and on the west side of Elliott Avenue W. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis.

With Alternative 2.1 or 2.1(s), guideway columns would be placed on the sidewalk and planter area of the west side of 16th Avenue W between W Emerson Street and W Dravus Street, transition to the west side of 15th Avenue W between W Dravus Street and the Galer Street overpass, and then would continue south in the center of Elliott Avenue W to W Harrison Street. By reconfiguring or relocating existing sidewalk and planter areas, the analysis assumed that most existing effective sidewalk widths could be maintained and/or widened to accommodate pedestrian volumes to and from the Green Line. Placement of guideway columns along the west side of 16th Avenue W and 15th Avenue W would be located to minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns. Placement of the guideway columns in the center median of Elliott Avenue W, however, would result in vehicular property access impacts. These impacts are expected in the form of reduced left-turn opportunities. Existing full access driveways and unsignalized intersections would be restricted to right-in, right-out access only to accommodate the guideway columns in the center of Elliott Avenue W. The vehicular access restrictions caused by the placement of guideway columns in the center two-way left-turn lane are not expected to significantly affect p.m. peak hour conditions, since the existing high northbound and southbound p.m. peak hour volumes on Elliott Avenue W currently make it difficult for vehicles to turn left into and out of unsignalized driveways and side streets. During off-peak periods, the left-turn prohibitions could result in some out-of-direction travel for motorists to reach their

destination. The analysis assumed that a new signal, southbound left/U-turn channelization, and pedestrian crosswalks could be provided at the Elliott Avenue W/W Lee Street intersection, which would reduce the potential for these impacts.

Alternative 2.2 would place guideway columns in an existing two-way left-turn lane in the center of 15th Avenue W. South of W Galer Street, Alternative 2.2 would follow the west side of Elliott Avenue W to W Harrison Street. By reconfiguring or relocating existing sidewalk and planter areas, the analysis assumed that most existing sidewalk widths could be maintained and/or widened to accommodate pedestrian volumes to and from the Green Line. Along 15th Avenue W, vehicular property access impacts are expected in the form of reduced left-turn opportunities. Existing full-access driveways and unsignalized intersections could be restricted to right-in, right-out access only to accommodate the columns in the center of 15th Avenue W. The vehicular access restrictions caused by the placement of guideway columns in the center two-way left-turn lane is not expected to significantly affect p.m. peak hour conditions, since the existing high northbound and southbound p.m. peak hour volumes on 15th Avenue W currently make it difficult for vehicles to turn left into and out of unsignalized driveways and side streets. During off-peak conditions, the left-turn prohibitions could result in some out-of-direction travel for motorists to reach their destinations. The analysis assumed that a new signalized intersection with left/U-turn channelization and pedestrian crosswalks could be provided at the 15th Avenue W/W Armour Street intersection, which would reduce the potential for these impacts. Along Elliott Avenue W, columns could be placed on the sidewalk and planter area of the west side of the roadway, which would not preclude left or right turning movements to and from adjacent businesses. Columns could be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Traffic Safety

Traffic safety impacts in the Interbay/Magnolia Segment are anticipated to be caused primarily by the introduction of guideway columns in the public right-of-way. Alternative 2.2 would likely result in greater traffic safety impacts than Alternative 2.1 or 2.1(s) because the potential safety benefit of restricting access with guideway columns located in the center of the roadway would likely be greater along Elliott Avenue W, due to the presence of frequent driveways and side streets.

Guideway columns in sidewalk or planter areas would be located to avoid impeding vehicular or pedestrian flow, and to provide adequate sight distance around the columns. This would affect Alternative 2.1 or 2.1(s) along 15th Avenue W between W Emerson Street and W Galer Street and Alternative 2.2 between W Galer Street and W Harrison Street.

With both Alternatives 2.1 (Elliott Avenue W south of W Galer Street) and 2.2 (15th Avenue W between W Emerson Street and W Galer Street), the introduction of guideway columns in the center of the street could result in a reduction in midblock accidents due to the elimination of left-turn movements at unsignalized intersections and driveways. Prohibiting these mid-block left turns would virtually eliminate the potential for midblock left-turn and right angle vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents. The reduction in accidents could potentially be higher with Alternative 2.1 or 2.1(s), due to the presence of frequent unsignalized driveways and side streets along Elliott Avenue W. On the other hand, left-turn restrictions at unsignalized intersections could lead to increased traffic due to out-of-direction travel. The analysis assumed that a new signal, southbound left/U-turn channelization, and pedestrian crosswalks at the Elliott Avenue W/W Lee Street intersection with Alternative 2.1 or 2.1(s), and at the 15th Avenue W/W Armour Street intersection with Alternative 2.2, would reduce the potential for these impacts. A traffic control measure may be implemented at the intersection of W Dravus Street and 17th Avenue W to allow for bus turning movements. See Chapter 5 for a discussion of mitigation measures.

The Green Line would result in increases in vehicular, transit, bicycle, and pedestrian activity in the vicinity of the stations. These stations would be designed to provide safe and convenient access for all travel modes.

Pedestrian and Bicycle Facility Impacts

The relatively low-density land uses and industrial development in the Interbay/Magnolia Segment contributes to the low pedestrian and high automobile volumes in this area. There are sidewalks on the major arterial streets near the station alternatives; however, sidewalk connections are missing at grade-separated crossings such as on W Dravus Street at 15th Avenue W and at the east end of the Magnolia Bridge. In addition, sidewalks do not exist along W Mercer Place between Elliott Avenue W and W Mercer Street, along 15th Avenue W between W Barrett Street and W Armour Street, and on Elliott Avenue W between W Lee Street and W Prospect Street.

In addition to the missing sidewalk connections, there are a few walk routes from the Green Line station alternatives to the Queen Anne neighborhood, located east of the Green Line stations. Curb ramps are currently missing at the following locations:

- W Dravus Street/16th Avenue W – Southwest and southeast corners of the intersections lack curb ramps.
- W Dravus Street/15th Avenue W Northbound Ramps – All corners.
- W Dravus Street/17th Avenue W – Southwest corner.

The 16th Avenue W/W Dravus Street intersection is an unsignalized intersection, where both the north and south legs are stop controlled, and the east and west legs are free flow. Pedestrian crosswalks are currently not provided on either the east or west legs of the 16th Avenue W/W Dravus Street intersection. In the future, the Dravus 1 and 1A station alternatives would likely attract riders from the south side of W Dravus Street, including pedestrians from the Interbay Athletic Complex, located south of these station alternative locations. Likewise, the Dravus 2A station alternative could attract riders from the north side of Dravus Street, including QFC and other retail patrons. There is currently no crosswalk to safely serve Green Line riders walking from the opposite side of W Dravus Street to access the Dravus station. Table 4.1-30 summarizes the number of pedestrian trips expected at each station.

Table 4.1-30. Interbay/Magnolia Segment: Nonmotorized Facility Impact Summary

Station Name and Alternative	2020 p.m. Peak Hour Walk Trips	
	Ingress	Egress
Dravus 1, 1A, 1B and 2 ^a	76	280
Howe 1, 1A and 2, and Prospect 3	24	17
Elliott and Mercer 1, 1A and 2	94	54

^a Represents a conservatively high estimate of walk trips based on the assumption that the Howe/Prospect Station would not be constructed.

All sidewalks near the Green Line station alternatives currently operate at LOS B, which suggests there is sufficient sidewalk width to allow pedestrians to select walking speeds to bypass other pedestrians and to avoid crossing conflicts with other pedestrians. All of the sidewalks within the study area would continue to operate at LOS B in the years 2010 and 2020 with both the No Action and all Green Line alignment and station alternatives. Some surges in pedestrian traffic would result from bus arrivals near the Green Line stations in the Interbay Segment. Even with these surges, sidewalks near these stations would operate at LOS B or better in the years 2010 and 2020.

There are bicycle routes and streets commonly used by bicyclists located near the Dravus station alternatives, which would provide Green Line passengers bicycle access in all directions. Gilman Avenue W, 20th Avenue W, and Thorndyke Avenue W provide on-street bicycle lanes that extend from the station area to the Magnolia neighborhood. 15th Avenue W north of the Dravus station is a street commonly used by bicyclists. This bicycle route connects to the W Nickerson Street bicycle route, which loops around the north side of Queen Anne and connects to the Dexter Avenue N bicycle route. In addition, the 14th Avenue W bicycle route extends in a north-south direction between W Dravus Street and Gilman Drive W, and the Gilman Drive W bicycle routes would provide bicycle access on the local streets in Upper and Lower Queen Anne. There are no bicycle routes south of the Gilman Drive West bicycle route; however, the existing bicycle routes near the Dravus Street station alternatives would provide sufficient bicycle access to the surrounding neighborhoods.

Table 4.1-31 summarizes the bicycle storage facilities proposed at each Green Line station based on projected bicycle demand near each station. Similar to the Ballard Segment, bicycle demand was categorized as low (250 square feet), medium (500 square feet), or high (1,000 square feet) based on surrounding land uses, ridership forecasts, and adjacent bicycle facilities. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. The higher figures represented in the table represent a longer-term space allocation, demonstrating how space could be provided for higher numbers of bicycles if demand increases.

Table 4.1-31. Interbay/Magnolia Segment: Proposed Bicycle Facilities

Station Name and Alternative	Proposed Bicycle Parking Area ^a	Bicycle Storage ^b (Number of Bicycles)
Dravus 1, 1A, 1B, and 2	1,000 square feet	48
Howe 1, 1A and 2, and Prospect 3	500 square feet	24
Elliott and Mercer 1, 1A, and 2	250 square feet	12

^a Space allocation includes areas for future expansion.

^b The number of bicycles accommodated assumes covered racks. The amount of parking provided at project opening may be less than shown.

Parking Impacts

Parking Supply

Green Line Alternatives 2.1, 2.1(s) and 2.2 in the Interbay/Magnolia Segment would result in a net loss of 41 to 193 parking spaces. These include a combination of on-street parking losses due to layover zones at stations, on- and off-street parking losses due to column placement, and off-street parking losses due to partial property takes for station facilities. These losses to existing parking supply are summarized by alignment alternative in Table 4.1-32. Parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS, are shown in Table 4.1-33. The parking losses shown in Table 4.1-33 for each station alternative are accounted for in the total parking losses summarized in Table 4.1-32.

As shown in Table 4.1-32, Alternatives 2.1.1 and 2.1.2 (West and Far West Connections from Ballard Crossing) and Alternative 2.1(s) would generally result in higher net parking losses than Alternative 2.2 (Center of 15th/West Side of Elliott). Alternative 2.1 would result in a loss of up to 14 on-street parking spaces on the west side of 15th Avenue W due to column placement and would not displace any on-street parking spaces on Elliott Avenue W due to column placement in the existing center two-way left-turn lane if no left and/or U-turn channelization is provided. However, if left and/or U-turn channelization is provided, up to 102 on-street parking spaces could be displaced from both the west and east sides of

Elliott Avenue W. Alternative 2.2 is assumed to convert all existing on-street (off-peak) parking on the west side of Elliott Avenue W to all-day parking. For Alternative 2.1, off-street parking losses due to column placement are expected to be slightly higher with the Far West Bridge Connection (Alternative 2.1.2) than with the West Bridge Connection (Alternative 2.1.1). Alternative 2.2 is expected to result in the lowest number of off-street parking spaces displaced.

Table 4.1-32. Interbay/Magnolia Segment: Total Parking Losses – By Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement or Switching Area		Parking Losses at Station Alternatives ^b		Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street	
2.1 – West Side 15th/Center Elliott^c	14 to 116	13 to 19	16 to 24	0 to 65	43 to 193
<i>2.1.1 – West Bridge Connection^c</i>	<i>14 to 116</i>	<i>13</i>	<i>16 to 24</i>	<i>0 to 34</i>	<i>43 to 187</i>
<i>2.1.2 – Far West Bridge Connection^c</i>	<i>14 to 116</i>	<i>19</i>	<i>16 to 24</i>	<i>0 to 34</i>	<i>49 to 193</i>
2.1(s) – Single Beam	14 to 116	37	24	0	75 to 177
2.2 – Center of 15th/West Side of Elliott	0	15	26 to 27	0 to 1	41 to 43

^a Parking impacts shown are permanent displacements due to guideway column placement, bus zones, drop-and-drive areas, and partial property takes associated with different alignment and station alternatives.

^b See Table 4.1-33 for a detailed breakdown of these potential parking losses.

^c The low range of parking losses shown assumes that no left or U-turns would be provided at signalized or unsignalized intersections along Elliott Avenue W due to column placement in the existing center two-way left-turn lane. The high range reflects the additional parking losses that could result if left/U-turn channelization is provided at the following signalized intersections on Elliott Avenue W, W Galer Street, W Lee Street, W Prospect Street, W Mercer Place, and W Mercer Street.

Impacts for the Preferred Alternative are presented in bold type.

Table 4.1-33. Interbay/Magnolia Segment: Parking Losses at Station Alternatives^b

Station	Spaces Displaced	Area Affected by Displacement
Dravus 1 (Alternative 2.1)	12	16 th Avenue W (6 spaces) ^a , W Dravus Street (6 spaces) ^a
Dravus 1A (Alternative 2.1)	44	16 th Avenue W (4 spaces) ^a , W Dravus Street (6 spaces) ^a , QFC parking lot (34 spaces)
Dravus 1B (Alternative 2.1 and 2.1(s))	12	16th Avenue W (6 spaces)^a, W Dravus Street (6 spaces)^a
Dravus 2 (Alternative 2.2)	20	15 th Avenue W (5 spaces) ^a , 16 th Avenue W (9 spaces) ^a , W Dravus Street (6 spaces) ^a
Howe 1 (Alternative 2.1)	7	15 th Avenue W (7 spaces) ^a
Howe 1A (Alternative 2.1 and 2.1(s))	12	15th Avenue W (12 spaces)^a
Howe 2 (Alternative 2.2)	8	15 th Avenue W (7 spaces) ^a , Magnolia Self Storage (1 space)
Prospect 3 (Alternative 2.2)	6	Elliott Avenue W (6 spaces) ^a
Elliott and Mercer 1 and 1A (Alternative 2.1)	0	None
Elliott and Mercer 2 (Alternative 2.2)	0	None
Switching Areas (Alternative 2.1(s)) ^c	24	At W. Armory Way (8 spaces), south of W Armory Way (7 spaces), north of W Blaine Street (9 spaces)
Switching Areas (Alternative 2.2)	7	South of Ballard Bridge (5 spaces), near W Mercer Place (2 spaces)

^a Required for bus layover, active bus stops, and/or drop-and-drive zones.

^b Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. Parking losses identified for private properties do not represent losses of all available on-site parking.

^c Parking underneath proposed switch locations has been assumed to be fully displaced. This is a conservatively high estimate of parking impacts for these areas since some parking spaces under switches could be maintained. Impacts for the Preferred Alternative are indicated in bold type.

As shown in Table 4.1-33, parking losses associated with the station alternatives are primarily associated with new bus stops, layover facilities, or designated drop-and-drive zones. Very few off-street parking displacements due to partial property takes are expected for the Interbay Segment station alternatives, except if station alternative Dravus 1A is selected.

The parking losses shown in Tables 4.1-32 and 4.1-33 would not result in significant impacts to parking supply in the Interbay Segment, since a total of 1,971 existing on-street unrestricted parking spaces are currently provided within 1/4-mile radius of the station alternatives in this segment.

Parking Demand

On-street unrestricted parking near the Interbay/Magnolia Segment stations is currently 42 to 79 percent used during the mid-day hours (Refer to Appendix OO of the Final EIS, Transportation Backup Information, for a more detailed discussion of existing parking supply and demand within 1/4-mile radius of each Green Line station alternative). The Dravus and Howe station areas could experience some hide-and-ride activity, particularly from patrons traveling from the Magnolia and Queen Anne neighborhoods. As shown in Table 4.1-17, approximately 15 passengers at the Dravus Station and 4 passengers at the Howe Station were assumed to access the Green Line via drop-and-drive during the p.m. peak hour in the year 2020. If on-street unrestricted parking continues to be available at these locations, some of these auto trips may choose to hide-and-ride near the Green Line stations. Near the Dravus and Howe stations, potential hide-and-ride parking demand could be accommodated by the relatively high available on-street unrestricted parking supply within 1/4-mile radius of Green Line stations (approximately 443 spaces at the Dravus Station and 171 parking spaces near the Howe Station) if parking management programs are not implemented. The Elliott and Mercer station area, which experiences the highest utilization during the midday period (79 percent), also experiences high parking utilization during the early morning hours (90 percent). As shown in Table 4.1-17, approximately 13 passengers were assumed to access the Green Line at this station via drop-and-drive during the p.m. peak hour in the year 2020. Due to the relatively high utilization rates and low existing parking supply near this station (32 unused parking spaces during the early morning hours and 83 unused parking spaces during the midday), there is minimal potential for hide-and-ride parking impacts even if no new parking restrictions are implemented at the time the Green Line opens.

Truck Circulation Impacts

In the Interbay/Magnolia Segment, Alternatives 2.1, 2.1(s), and 2.2 are located on 15th Avenue W and Elliott Avenue W, which are both currently classified as T-2 truck routes (320 to 800 large trucks per day). Most trucks using this route would travel through the Interbay/Magnolia Segment or would access Port of Seattle Terminal 86 and Terminal 91 via W Galer Street. Neither of the Green Line alternative alignments would significantly affect these trips, as roadway widths and turning radii required for truck movement through this corridor would be maintained. However, some local truck circulation impacts may result from Alternative 2.1 or 2.1(s) along Elliott Avenue W and from Alternative 2.2 along 15th Avenue W due to the addition of center columns in these roadway segments. A more detailed discussion of each alternative follows.

Alternative 2.1 or 2.1(s) would locate guideway columns on the west side of 16th Avenue W and 15th Avenue W in sidewalk and planter areas, and then transition to the center two-way left-turn lane along Elliott Avenue W to W Harrison Street. Placement of columns along the west side of 16th Avenue W and 15th Avenue W would be designed to minimize impacts to left or right turning movements to and from businesses and side streets. No truck circulation impacts would be expected if columns are located to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. Along Elliott Avenue W, placement of guideway columns in

the center of the roadway would restrict full-access driveways and unsignalized intersections to right-in, right-out access only. Left turns would be restricted to signalized intersections and U-turns would be permitted for passenger vehicles and single-unit delivery vehicles at most signalized intersections to minimize the impact of these left-turn restrictions. “Jug-handle” U-turn routes would be provided for trucks at W Galer Street and W Garfield Street and at Sixth Avenue W and W Mercer Place.

With Alternative 2.2, guideway columns would be placed in the center of 15th Avenue W and transition to the west side of Elliott Avenue W. Along 15th Avenue W, placement of guideway columns in the existing center two-way left-turn lane would restrict full-access driveways and unsignalized intersections to right-in, right-out access only. Left turns would be restricted to signalized intersections and U-turns would be permitted for passenger vehicles and single-unit delivery vehicles at most signalized intersections to minimize the impact of these left-turn prohibitions. Placement of the columns along the west side of Elliott Avenue W would be designed to minimize impacts to left or right turning movements to and from businesses and side streets. No truck circulation impacts would be expected if columns are located to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks.

Preferred Alternative

In the Interbay/Magnolia Segment, Alternative 2.1 along the west side of 15th Avenue W and center of Elliott Avenue W in a dual beam alignment, with the Dravus 1B (Barrett) and Elliott and Mercer 1A Station Alternatives, is the Preferred Alternative. The guideway would be constructed to allow for a future station in the Howe/Blaine area (Howe 1A). In addition, switches would be located to allow access to an Operations Center (C-1) west of 15th Avenue W near W Armory Way. The Preferred Alternative would not preclude the possibility of a future Galer off-ramp.

For the Preferred Alternative, guideway columns would be placed on the west side of 15th Avenue W, removing a southbound parking/peak travel lane south of W Dravus Street. Along Elliott Avenue W, guideway columns would be placed in the existing center two-way left-turn lane, restricting left turns to and from unsignalized driveways and intersections. The analysis assumed that left turn movements could be retained at the following signalized intersections: W Garfield Street, Galer Street flyover, W Lee Street, W Prospect Street, W Mercer Place, and W Mercer Street. In addition, U-turns would be permitted for passenger vehicles and single-unit delivery vehicles at the Galer Street flyover (southbound only), W Lee Street (southbound only), W Prospect Street, W Mercer Place, and W Mercer Street (southbound only) signalized intersections to minimize the impact of these left-turn prohibitions. The southbound and northbound off-peak parking/peak travel lanes would be displaced to accommodate left and U-turns at these signalized intersections.

Table 4.1-27 summarizes the results of the p.m. peak hour level of service (LOS) analysis conducted for Alternative 2.1, assuming that the southbound parking/peak travel lane would be removed from 15th Avenue W south of W Dravus Street, and that both the southbound and northbound off-peak parking/peak travel lanes would be displaced along Elliott Avenue W. As shown in this table, the W Dravus Street/16th Avenue W, 15th Avenue W/W Armour Street, and 15th Avenue W/W Wheeler Street intersections would operate at LOS F with the No Action and Preferred Alternatives in the year 2010. By the year 2020, the northbound and southbound 15th Avenue W ramp terminal intersections at W Dravus Street would also operate at LOS F with the No Action and Preferred Alternatives. Delay increases associated with the Green Line would be minimal at all of these locations. The Elliott Avenue W/W Mercer Place intersection would also operate at LOS F in the year 2020 with the Preferred Alternative (compared to LOS C with the No Action Alternative). This change in intersection LOS is primarily due to the removal of a northbound travel lane. Table 4.1-29 summarizes the a.m. peak hour LOS analysis results for selected intersections in the Interbay Segment. The study intersections for the a.m. peak hour

would operate at LOS E or better conditions. Overall, the Preferred Alternative would result in similar LOS impacts as the No Action Alternative and Alternative 2.2. Exceptions include the 15th Avenue W/W Armour Street, and 15th Avenue W/W Wheeler Street intersections, which would operate better with Alternative 2.2 due to the provision of new traffic signals. As described above, the Preferred Alternative would also result in a worsening of LOS at the Elliott Avenue W/W Mercer Place intersection.

With regard to access and circulation, safety, and potential truck circulation impacts, placement of Green Line guideway columns on the west side of 16th Avenue W and 15th Avenue W would be located to minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to avoid impeding vehicular, pedestrian, and truck circulation at side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns. By reconfiguring or relocating existing sidewalk and planter areas, the analysis assumed that all existing effective sidewalk widths could be maintained and/or widened to accommodate pedestrian volumes to and from the Green Line.

Placement of the guideway columns in the center median of Elliott Avenue W, however, would result in some vehicular property access and truck circulation impacts. These impacts are expected in the form of reduced left-turn opportunities at unsignalized intersections. Existing full access driveways and unsignalized intersections would be restricted to right-in, right-out access only to accommodate the guideway columns in the center of Elliott Avenue W. Left turns would be restricted to signalized intersections and U-turns would be permitted for passenger vehicles and single-unit delivery vehicles at most signalized intersections to minimize the impact of these left-turn restrictions. The analysis assumed that a new signal, southbound left/U-turn channelization for passenger vehicles and single-unit delivery vehicles, and pedestrian crosswalks could also be provided at the Elliott Avenue W/W Lee Street intersection, which would reduce the potential for access and circulation impacts. The vehicular access restrictions caused by the placement of guideway columns in the center two-way left-turn lane are not expected to significantly affect p.m. peak hour conditions, since the existing high northbound and southbound p.m. peak hour volumes on Elliott Avenue W currently make it difficult for trucks and passenger cars to turn left into and out of unsignalized driveways and side streets. “Jug-handle” U-turn routes would be provided for trucks at W Galer and W Garfield Streets and at Sixth Avenue W and W Mercer Place.

With regard to safety impacts, the introduction of guideway columns in the center of the street could result in a reduction in midblock accidents due to the elimination of left-turn movements at unsignalized intersections and driveways. Prohibiting these mid-block left turns would virtually eliminate the potential for midblock left-turn and right angle vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents. On the other hand, left-turn restrictions at unsignalized intersections could lead to increased traffic due to out-of-direction travel for a distance of up to one mile. The analysis assumed that with a new signal, left/U-turn channelization, and pedestrian crosswalks could be provided at the Elliott Avenue W/W Lee Street intersection, which would reduce the potential for these impacts. For a discussion of mitigation measures, see Chapter 5.

Both 15th Avenue W and Elliott Avenue W are currently classified as T-2 truck routes (320 to 800 large trucks per day) and major truck streets in the City of Seattle’s Comprehensive Plans. Most trucks using this route would travel through the Interbay Segment or would access Port of Seattle Terminal 86 and Terminal 91 via W Galer Street. The Preferred Alternative would not significantly affect these trips, as roadway widths and turning radii required for truck movement through this corridor would be maintained.

Overall, with regard to access and circulation, safety, and potential truck circulation impacts, the potential for access and circulation and truck circulation impacts could be slightly higher with the Preferred

Alternative than with Alternative 2.2, due to the presence of more frequent unsignalized driveways and side streets along Elliott Avenue W than along 15th Avenue W. On the other hand, access restrictions along Elliott Avenue with the Preferred Alternative could result in a reduction of midblock accidents in this segment. Therefore, the potential for traffic safety impacts could be lower with the Preferred Alternative than with Alternative 2.2.

Table 4.1-30 summarizes the number of pedestrian trips that would be expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B in the years 2010 and 2020 with the Preferred Alternative. There are bicycle routes and streets commonly used by bicyclists located near the Dravus 1A Station, which would provide Green Line passengers bicycle access in all directions. There are no bicycle routes south of the Gilman Drive West bicycle route; however, the existing bicycle routes near the Dravus Station would provide sufficient bicycle access to the surrounding neighborhoods. The SMP Board has determined to provide, at initial operations, 20 bicycle spaces at all stations in the Interbay Segment. Table 4.1-31 summarizes the longer-term space allocation proposed for bicycle storage at each Green Line station if bicycle demand increases.

A total loss of approximately 162 (125 on-street, 37 off-street) parking spaces would be expected from the Preferred Alternative. A breakdown of losses associated with Alternative 2.1 is shown in Tables 4.1-32 and 4.1-33 for Alternative 2.1 and the Dravus 1B, future Howe 1A, and Elliott and Mercer 1A stations. Approximately 14 on-street parking spaces could be displaced on 15th Avenue W due to column placement. Along Elliott Avenue W, up to 102 on-street parking spaces could also be displaced from both the west and east sides of the street to provide for left and/or U-turn channelization at signalized intersections. In addition, up to 13 off-street parking spaces on private property could also be displaced due to column placement in the Interbay/Magnolia Segment. The Dravus 1B Station is expected to displace approximately nine on-street parking spaces for new bus stops and drop-and-drive zones. Approximately 12 on-street parking spaces would also be displaced near the Howe 1A Station when it is constructed to accommodate bus stops and drop-and-drive locations. No parking losses are expected at the Elliott and Mercer 1A Station. These parking losses would not result in significant impacts to existing parking supply, since a total of 1,971 existing on-street unrestricted parking spaces are currently provided within ¼-mile radius of the station locations. The Dravus station area also could experience some hide-and-ride activity from patrons traveling from the Magnolia and Queen Anne neighborhoods, since the existing unused parking supply of approximately 443 parking spaces far exceeds the potential hide-and-ride parking demand if parking management programs are not implemented. Overall, the Preferred Alternative would result in a greater loss of parking supply than Alternative 2.2.

Queen Anne/Seattle Center/Belltown Segment

For traffic analysis purposes, Alternatives 3.1 (Seattle Center/Republican) and 3.3 (Thomas) would maintain the existing number of travel lanes on W Harrison Street and Fifth Avenue. On-street parking would be removed from the south side of W Harrison Street and on the east side of Fifth Avenue. For analysis purposes, it was assumed that all-day parking could be provided between columns on W Harrison Street. The cross-sections proposed for both of these streets maintain lane widths that are consistent with existing conditions. Alternative 3.1.4 as it travels above the center of Fifth Avenue N would also displace all on-street parking on the west side of Fifth Avenue N.

Alternative 3.2 (Mercer) would also maintain the same number of lanes as exists today on W Harrison Street, Warren Avenue N, Mercer Street, and Fifth Avenue N; one travel lane would be removed on Fifth Avenue between Denny Way and Stewart Street. On-street parking would be removed from the north side of W Harrison Street, the west side of Warren Avenue, and the west side of Fifth Avenue. For analysis purposes, it was assumed that all-day parking could be provided between guideway columns on the north side of W Harrison Street, the west side of Warren Avenue N, the east side of Fifth Avenue N,

and the west side of Fifth Avenue. All lane widths assumed in the traffic analysis are consistent with existing conditions.

Alternative 3.5 (Denny) was assumed to provide the same cross-sections on W Harrison Street and Fifth Avenue as Alternatives 3.1 and 3.3. On Denny Way, Alternative 3.5 was assumed to eliminate the eastbound curb lane. Existing lane widths were assumed to be maintained along Denny Way.

Traffic Volumes and Level of Service

Table 4.1-34 summarizes the LOS evaluation results for weekday p.m. peak hour conditions in the years 2010 and 2020 with the No Action and Green Line Alternatives in the Queen Anne/Seattle Center/Belltown Segment. Three different station areas were evaluated for each alignment alternative. For Alternative 3.1, two Belltown station alternatives are currently being considered (Belltown 1 and Belltown 2). Both station alternatives would have very similar traffic impacts and therefore were not evaluated separately for Alternative 3.1.

As shown in Table 4.1-34, there is little difference in projected intersection delays among most of the alternatives for both years 2010 or 2020, and no significant LOS changes. The only exceptions are with Alternative 3.2, which would decrease the number of travel lanes on Fifth Avenue between Denny Way and Stewart Street from three to two lanes, and with Alternative 3.5, which would eliminate an eastbound travel lane on Denny Way between Second Avenue and Fifth Avenue to accommodate guideway columns on the south side of the street. Alternatives 3.1 and 3.3 would also provide the guideway in a center median. In general, the weaving restrictions associated with center alignments on one-way streets reduces the effective capacity of the remaining travel lanes, because drivers must choose the lanes that will allow the local access or turning movement associated with their trip. This indirect impact exists even without weaving restrictions (i.e., with Alternatives 3.2 and 3.5), particularly during the peak period when high traffic volumes make it more difficult to weave between travel lanes.

For all other alternatives, the primary differences are in which side of the street passenger loading and on-street parking take place, which are both relatively minor factors in determining average intersection delay. Individual peak hour turning movements at the study intersections vary by no more than 30 vehicles per hour among the alternatives, which is a small percent of overall intersection traffic.

All intersections evaluated would operate at LOS E or better in the year 2010 with the No Action and Green Line Alternatives. In the year 2020, the Denny Way/Second Avenue intersection would operate at LOS F with the No Action and all Green Line alternative alignments. Average delays at this intersection would increase by approximately 3.2 seconds in the year 2020 with the Green Line alternatives due to the addition of drop-and-drive vehicle trips to the critical southbound left and westbound through movements. This slight increase in delay is not considered significant. The Denny Way/Broad Street intersection would change from LOS D with the No Action Alternative to LOS F with Alternative 3.5 due to the elimination of the eastbound curb lane on Denny Way. The removal of the eastbound curb lane would cause the eastbound through critical movement at this intersection to change from LOS C with the No Action Alternative to LOS F for both the years 2010 and 2020. With the removal of this eastbound lane, the Denny Way/Fifth Avenue intersection would change from LOS C with the No Action Alternative to LOS E with Alternative 3.5 in the year 2020. In both years 2010 and 2020, the eastbound through critical movement would change from LOS B with No Action to LOS F with this capacity reduction.

Table 4.1-34. Queen Anne/Seattle Center/Belltown Segment: p.m. Peak Hour Level of Service Summary 2010 and 2020 No Action and Green Line Alternatives

Intersection	Existing	Year 2010						Year 2020					
		No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5	No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5
Harrison Street/First Avenue	B (14.2)	B (15.0)	B (14.9) ^a	B (14.9) ^a	B (14.9) ^a	B (14.9) ^b	B (14.9) ^a	B (15.8)	B (15.8) ^a	B (15.8) ^a	B (15.8) ^a	B (15.8) ^b	B (15.8) ^b
Harrison Street/Queen Anne Avenue	B (18.4)	B (18.1)	B (18.1) ^a	B (18.1) ^a	B (18.1) ^a	B (18.0) ^b	B (18.1) ^b	B (18.0)	B (17.8) ^a	B (17.8) ^a	B (17.8) ^a	B (17.9) ^b	B (17.9) ^b
Denny Way/First Avenue	D (36.5)	D (47.8)	D (49.8) ^c	D (49.8) ^d	D (49.8) ^e	D (49.8) ^c	D (49.8) ^f	E (69.1)	E (71.3) ^c	E (71.3) ^d	E (71.3) ^e	E (71.3) ^c	E (71.3) ^f
John Street/Fifth Avenue N	A (8.0)	A (8.2)	A (9.4) ^c	A (9.4) ^d	A (9.4) ^e	A (9.4) ^c	A (9.6) ^f	A (8.5)	A (10.0) ^c	A (10.0) ^d	A (10.0) ^e	A (10.0) ^c	A (9.9) ^f
Broad Street/Fifth Avenue N	C (25.3)	C (26.1)	C (26.6) ^c	C (26.6) ^d	C (26.5) ^e	C (26.6) ^c	C (26.6) ^f	C (27.0)	C (27.4) ^c	C (27.4) ^d	C (27.3) ^e	C (27.4) ^c	C (27.5) ^f
Denny Way/Broad Street	C (24.4)	C (30.8)	C (32.3) ^c	C (32.3) ^d	C (32.3) ^e	C (32.4) ^c	E (64.5) ^f	D (40.5)	D (40.5) ^c	D (40.5) ^d	D (40.5) ^e	D (38.7) ^c	F (83.1) ^f
Denny Way/Second Avenue	C (24.9)	E (50.0)	E (56.5) ^c	E (56.5) ^d	E (56.5) ^e	E (56.5) ^c	E (56.5) ^f	F (86.2)	F (89.4) ^c	F (89.4) ^d	F (89.4) ^e	F (89.4) ^c	F (89.4) ^f
Denny Way/Fifth Avenue	B (17.8)	B (19.1)	B (19.0) ^c	B (19.0) ^d	B (19.0) ^e	B (19.1) ^c	D (49.9) ^f	C (22.2)	C (22.3) ^c	C (22.3) ^d	C (22.3) ^e	C (22.3) ^c	E (61.3) ^f
Fifth Avenue/Vine Street	B (10.2)	B (10.4)	A (9.8) ^g	A (9.8) ^g	A (9.9) ^g	A (9.7) ^g	A (9.7) ^h	B (10.8)	A (9.6) ^g	A (9.6) ^g	A (9.8) ^g	A (9.6) ^g	B (10.8) ^h
Fifth Avenue/Wall Street	A (8.7)	A (8.5)	A (8.3) ^g	A (8.3) ^g	A (8.4) ^g	A (8.3) ^g	A (8.2) ^h	A (9.0)	A (8.8) ^g	A (8.8) ^g	A (9.0) ^g	A (8.8) ^g	A (8.9) ^h
Fifth Avenue/Battery Street	B (15.6)	B (15.6)	B (16.6) ^g	B (16.6) ^g	B (17.5) ^g	B (16.6) ^g	B (16.6) ^h	B (15.6)	B (16.8) ^g	B (16.8) ^g	B (17.9) ^g	B (16.8) ^g	B (16.4) ^h
Fifth Avenue/Bell Street	B (16.4)	B (17.7)	B (17.0) ^g	B (17.0) ^g	B (18.5) ^g	B (17.0) ^g	B (16.8) ^h	B (19.3)	B (19.1) ^g	B (19.1) ^g	C (20.5) ^g	B (19.1) ^g	B (18.8) ^h

Table 4.1-34. Queen Anne/Seattle Center/Belltown Segment: p.m. Peak Hour Level of Service Summary 2010 and 2020 No Action and Green Line Alternatives (continued)

Intersection	Existing	Year 2010						Year 2020					
		No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5	No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5
Fifth Avenue/ Blanchard Street	B (11.8)	B (12.0)	B (12.2) ^g	B (12.2) ^g	B (13.1) ^g	B (12.2) ^g	B (12.2) ^h	B (12.8)	B (13.1) ^g	B (13.1) ^g	B (14.2) ^g	B (13.1) ^g	B (13.0) ^h

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

^a Evaluated with the Seattle Center/Queen Anne 1/1A (North) station.

^b Evaluated with the Seattle Center/Queen Anne 2 (South) station.

^c Evaluated with the Seattle Center/Fifth and Broad 1 (Southeast) station.

^d Evaluated with the Seattle Center/Fifth and Broad 1A (Southeast) station.

^e Evaluated with the Seattle Center/Fifth and Broad 2 (Harrison) station.

^f Evaluated with the Denny 3 station.

^g Evaluated with the Belltown 1 (Center - West) station.

^h Evaluated with the Belltown 2 (Center - East) station.

ⁱ Evaluated with the Belltown 3 (West) station.

Table 4.1-35 summarizes the a.m. peak hour analysis results for four key study intersections identified for analysis. As shown in Table 4.1-35, year 2010 and 2020 a.m. peak hour traffic operations are comparable to p.m. peak hour conditions at the intersections selected for a.m. analysis. The Broad Street/Fifth Avenue N, Fifth Avenue/Battery Street, and Fifth Avenue/Bell Street intersections currently operate and would continue to operate with lower delays during the a.m. peak hour than during the p.m. peak hour with the No Action and Green Line Alternatives. The Denny Way/Fifth Avenue intersection currently operates and would continue to operate with worse delays during the a.m. peak hour than during the p.m. peak hour with the No Action and Green Line Alternatives. The removal of one eastbound through lane on Denny Way, as proposed with Alternative 3.5, would cause this intersection to change to LOS F in the year 2020.

Table 4.1-35. Queen Anne/Seattle Center/Belltown Segment: a.m. Peak Hour Level of Service Summary 2010 and 2020 No Action and Green Line Alternatives

Intersection	Existing	Year 2010						Year 2020					
		No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5	No Action	Alts. 3.1.1 / 3.1.2	Alt. 3.1.4	Alt. 3.2	Alt. 3.3	Alt. 3.5
Broad Street/ Fifth Avenue N	C (23.6)	C (24.7)	C (24.7)	C (24.7)	C (24.5)	C (24.4)	C (24.4)	C (25.6)	C (25.6)	C (25.6)	C (25.2)	C (25.0)	C (25.2)
Denny Way/ Fifth Avenue	C (21.7)	C (23.4)	C (27.2)	C (27.2)	C (27.2)	C (26.8)	E (55.2)	C (27.8)	C (27.9)	C (27.9)	C (27.9)	C (26.8)	F (104.6)
Fifth Avenue/ Battery Street	A (8.8)	A (8.7)	A (8.7)	A (8.7)	A (9.4)	A (8.8)	A (8.7)	A (9.3)	A (9.3)	A (9.3)	B (10.4)	A (9.2)	A (9.2)
Fifth Avenue/ Bell Street	A (6.9)	A (7.8)	A (8.0)	A (8.0)	A (8.0)	A (8.0)	A (8.0)	A (9.5)	A (9.8)	A (9.8)	B (10.1)	A (9.9)	A (9.8)

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

Access and Circulation

Property access impacts in the Queen Anne/Seattle Center/Belltown Segment differ for each alignment alternative, depending on the location of the guideway within the W Harrison Street and Fifth Avenue rights-of-way and along other streets such as W Mercer Street, Fifth Avenue N, and Denny Way.

Overall, Alternative 3.5 would have the greatest potential for access and circulations impacts, since the alignment would travel along the greatest number of streets. Alternative 3.5 would be followed by Alternatives 3.1 and 3.3 (which would result in the same level of impact). Alternative 3.2 would have the least potential for affecting access and circulation. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis. Between W Harrison Street and Seattle Center, Alternatives 3.1, 3.3, and 3.5 would locate guideway columns on the south side of W Harrison Street, and Alternative 3.2 would locate guideway columns on the north side of W Harrison Street. For all alternatives, the columns would be placed within an existing parking lane, which would minimize impacts to left or right turning movements to and from adjacent businesses. Columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

In the Seattle Center Area to Fifth Avenue N, Alternatives 3.1 and 3.3 are primarily located within the Seattle Center, resulting in no vehicular access and circulation impacts. With Alternative 3.2, the

guideway columns would be placed on the west side of Warren Street within the existing parking lane, on the north side of Mercer Street, and on the east side of Fifth Avenue N (supported by straddle bents). The Alternative 3.5 alignment would also place guideway columns on the east side of Second Avenue N (supported by straddle bents), and in the eastbound curb lane of Denny Way. For both Alternatives 3.2 and 3.5, placement of columns on all of these streets would be designed to minimize impacts to left or right turning movements to and from adjacent businesses. Along all of these roadways, columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Along Fifth Avenue in Belltown, columns would be placed in the center of the street with Alternatives 3.1, 3.3, and 3.5. Vehicles could be prevented from passing between columns to change lanes; however, this could result in some out-of-direction travel for drivers to reach their destinations. With Alternative 3.2, the guideway columns would be located on the west side of Fifth Avenue within an existing travel lane midway between the west and center of the street. Column placement would be planned to minimize impacts to left or right turning movements to and from adjacent businesses, to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Traffic Safety

Traffic safety impacts in the Queen Anne/Seattle Center/Belltown Segment are primarily caused by the introduction of guideway columns in public right-of-way. Overall, Alternative 3.5 would result in the highest traffic safety impacts since the alignment would travel along the greatest number of streets and would constrain Denny Way. Alternatives 3.1 and 3.3 would have less of an impact to traffic safety than Alternative 3.5. Alternative 3.2 along the west of center of Fifth Avenue would result in the least impacts to traffic safety on Fifth Avenue, since no guideway columns would be placed in the center of the street.

In most areas, columns would be placed in sidewalk, planter, or parking areas to minimize impeding vehicular or pedestrian flow, and to provide adequate sight distance around the columns.

With Alternatives 3.1, 3.3, and 3.5, the introduction of new guideway columns in the center of Fifth Avenue (in place of the existing monorail columns) could present new access restrictions. This could result in driver confusion and create some potential for new accidents, as vehicles may attempt to change lanes through signalized intersections. However, it would more likely result in fewer collisions with columns and other accidents caused by limited sight distance between columns than the current monorail system. With Alternative 3.2.1, the removal of the existing monorail structure and columns in the center of Fifth Avenue would result in improved sight distance for vehicles changing lanes.

Alternative 3.2 would result in fewer traffic safety impacts than Alternatives 3.1, 3.3, and 3.5, since monorail guideway columns would be placed in sidewalk, planter, or parking areas. However, some potential traffic safety impacts could occur on the south side of Mercer Street due to the curb lane width reduction from 18 to 11 feet. This curb lane is currently used as a short-term parking/passenger loading zone for classes and events at Phelps Center and McCaw Hall.

The Green Line would result in increases in vehicular, transit, bicycle, and pedestrian activity in the vicinity of the proposed station alternatives. These stations would be designed to provide safe and convenient access for all travel modes.

Pedestrian and Bicycle Facility Impacts

Land use characteristics surrounding the Queen Anne/Seattle Center/Belltown stations promote high pedestrian activity throughout the day. Pedestrian volumes are particularly high around the Seattle Center and Key Arena, and the lower Queen Anne/Uptown commercial district. Sidewalk widths are designed to adequately serve these high pedestrian volumes; however, during major events the sidewalks experience some congestion.

The Green Line would travel on arterial streets and, depending on which alternative is chosen, could travel through the Seattle Center (Alternatives 3.1 and 3.3). Outside the Seattle Center, there are sidewalks on all arterial streets near the station alternatives. These sidewalks would provide Green Line passengers safe and direct access to and from the stations. All of the sidewalks within the immediate vicinity of the stations have curb ramps. Aurora Avenue north of Denny Way currently acts as a barrier to pedestrian flows east of the Seattle Center.

Seattle Center and SMP staff have identified existing walkway “pinch points” where pedestrian flows are often constricted within the Seattle Center. Some of these areas could be affected with alignment Alternatives 3.1 or 3.3, which travel through Seattle Center. Pinch point locations that could be affected by Alternative 3.1 include a section of the pedestrian walkway extending east from Republican Street to Kobe Bell and a section of the walkway between Memorial Stadium and the Center House. Alternative 3.3 could affect a section of the pedestrian walkway between the Center House and Mural Amphitheater. Guideway columns could be placed to avoid impeding pedestrian flows through these identified pinch points. Table 4.1-36 summarizes the number of pedestrian trips expected at each Green Line station alternative. No new pedestrian improvements are proposed for Green Line stations in this segment.

**Table 4.1-36. Queen Anne/Seattle Center/Belltown Segment:
Nonmotorized Facility Impact Summary**

Station Name and Alternative	2020 P.M. Peak Hour Walk Trips	
	Ingress	Egress
Seattle Center/Queen Anne 1, 1A, and 2	134	226
Seattle Center/Fifth and Broad 1, 1A, and 2, Denny 3	28	23
Belltown 1, 1A, 2, and 3	186	91

All sidewalks near the station alternatives currently operate at LOS B and would continue to do so in the years 2010 and 2020 with the No Action and all Green Line station alternatives. Some surges in pedestrian traffic would result from bus arrivals near the stations. Even with these surges, sidewalks near these stations would operate at LOS B or better in the years 2010 and 2020 for all station alternatives.

Bicycle connections are identified near all of the Green Line station alternatives in the Queen Anne/Seattle Center/Belltown Segment. Bicycle lanes exist along Dexter Avenue, which extends from the Fremont neighborhood to Downtown Seattle. The Dexter Avenue bicycle route is located in close proximity to the Fifth/Broad station; however, Aurora Avenue acts as a barrier between this route and the Fifth/Broad station. The Dexter Avenue bicycle route connects to other bicycle routes such as the Ship Canal Trail to the north, and arterial streets commonly used by bicyclists to the south. Green Line riders could use these routes to access the surrounding neighborhoods. There are also east-west bicycle routes on Bell Avenue and Blanchard Avenue. The Potlatch Trail is another pedestrian and bicycle facility proposed in the area, which would connect South Lake Union, Seattle Center, and Elliott Bay.

Table 4.1-37 summarizes the bicycle storage facilities proposed at each Green Line station, based on projected bicycle demand. Similar to the Ballard and Interbay Segments, bicycle demand was categorized as low (250 square feet), medium (500 square feet), or high (1,000 square feet) based on surrounding land uses, ridership forecasts, and adjacent bicycle facilities. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. The higher figures represented in the table represent a longer-term space allocation, demonstrating how space could be provided for higher numbers of bicycles if demand increases.

Table 4.1-37. Queen Anne/Seattle Center/Belltown Segment: Proposed Bicycle Facilities

Station Name and Alternative	Proposed Bicycle Parking Area ^a	Bicycle Storage ^b (Number of Bicycles)
Seattle Center/Queen Anne 1, 1A, and 2	500 square feet	24
Seattle Center/Fifth and Broad 1, 1A, and 2, Denny 3	250 square feet	12
Belltown 1, 1A, 2, and 3	NA	NA

^a Space allocation includes areas for future expansion.

^b The number of bicycles accommodated assumes covered racks. The amount of parking provided at project opening may be less than shown.

Parking Impacts

Parking Supply

The four alignment alternatives and station configurations in the Queen Anne/Seattle Center/Belltown Segment would result in a net loss of 84 to 220 parking spaces (10 to 15 parking spaces between W Harrison Street and Seattle Center, 46 to 150 parking spaces between Seattle Center Area and Fifth Avenue N, and 25 to 59 parking spaces on Fifth Avenue in Belltown). These include a combination of on-street parking losses due to layover zones at stations, on- and off-street parking losses due to column placement, and off-street parking losses due to property takes for station facilities. These losses to existing parking supply are summarized by alignment alternative and subsegment in Table 4.1-38. Table 4.1-39 summarizes the parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS. The parking losses shown in Table 4.1-39 for each station alternative are accounted for in the total parking losses summarized in Table 4.1-38.

Table 4.1-38. Queen Anne/Seattle Center/Belltown Segment: Total Parking Losses by Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement		Parking Losses at Station Alternatives ^b		Potential New All-Day On-Street Parking Spaces ^c	Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street		
W Harrison Street to Seattle Center						
3.1 - Seattle Center/Republican	10	1 to 3	0	0	0	11 to 13
3.2 – Mercer	12	1 to 3	0	0	0	13 to 15
3.3 – Thomas	10	0	0	0	0	10
3.5 - Second/Denny	10	1	0	0	0	11

Table 4.1-38. Queen Anne/Seattle Center/Belltown Segment: Total Parking Losses by Alignment Alternative ^a (continued)

Alternative	Parking Losses Due to Column Placement		Parking Losses at Station Alternatives ^b		Potential New All-Day On-Street Parking Spaces ^c	Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street		
Seattle Center Area to Fifth Avenue N						
3.1 - Seattle Center/Republican	0	0	9	43	0	52
3.1.4 – Revised Fifth Avenue	5	0	7	68	0	80
3.2 – Mercer	8	17	6	35	20	46
3.2.3 –Revised Mercer	8	19	7	68	20	82
3.3 – Thomas	0	0	13 to 15	75 to 100	0	90 to 113
3.5 - Second/Denny	0	100	18	32	0	150
Fifth Avenue (from Denny Way to Virginia Street)						
3.1 - Seattle Center/Republican	59	0	0	0	0	59
3.2 – Mercer	25	0	0	0	0	25
3.3 – Thomas	59	0	0	0	0	59
3.5 - Second/Denny	59	0	0	0	0	59

^a Parking impacts shown are permanent displacements due to guideway column placement, bus zones, drop-and-drive areas, and property takes associated with different alignment and station alternatives.

^b See Table 4.1-39 for a detailed breakdown of these potential parking losses.

^c New on-street parking spaces could be added between guideway columns in some locations where parking does not currently exist.

Table 4.1-39. Queen Anne/Seattle Center/Belltown Segment: Parking Losses at Station Alternatives ^b

Station	Spaces Displaced	Area Affected by Displacement
Seattle Center/Queen Anne 1 (Alts. 3.1 and 3.2)	3	Republican Street (3 spaces) ^a
Seattle Center/Queen Anne 1A (Alts. 3.1 and 3.2)	3	Republican Street (3 spaces) ^a
Seattle Center/Queen Anne 2 (Alts. 3.3 and 3.5)	41	First Avenue N (9 spaces) ^a , Key Arena (32 spaces)
Seattle Center/Fifth and Broad 1 (Alts. 3.1.4 and 3.3)	49	John Street (6 spaces) ^a , two surface parking lots on Fifth Avenue N (43 spaces)
Seattle Center/Fifth and Broad 1A (Alt. 3.1.4 and 3.2.3)	72	John Street (2 spaces) ^a , 2 spaces between John Street and Broad Street, Space Needle surface parking lot (68 spaces)
Seattle Center/Fifth and Broad 2 (Alt. 3.2)	38	Harrison Street (3 spaces) ^a , surface parking lot on Fifth Avenue N (35 spaces)
Denny 3 (Alt. 3.5)	9	Clay Street (9 spaces) ^a
Belltown 1 (Alt. 3.1, 3.2, 3.3, 3.5)	0	None
Belltown 1A (Alt. 3.1, 3.2, 3.3, 3.5)	0	None
Belltown 2 (Alts. 3.1, 3.3, and 3.5)	0	None
Belltown 3 (Alt. 3.2)	0	None

^a Required for bus layover, active bus stops, and/or drop-and-drive zones.

^b Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. Parking losses identified for private properties do not represent losses of all available on-site parking, with the exception of the surface parking lots displaced by the Seattle Center/Fifth and Broad 1 and 2 and Belltown 2 station alternatives

As shown in Table 4.1-38, Alternative 3.5 (Second/Denny) would result in the highest overall net parking loss, followed by Alternatives 3.1 (Seattle Center/Republican) and 3.3 (Thomas). Alternative 3.2 (Mercer) displaces a number of on-street parking spaces, but for analysis purposes was also assumed to add up to 20 on-street parking spaces between guideway columns on the east side of Fifth Avenue N.

Between W Harrison Street and the Seattle Center, all alternatives would displace some parking spaces due to column placement on W Harrison Street (Alternatives 3.1, 3.3, and 3.5 – approximately ten spaces on south side, Alternative 3.2 – approximately 12 spaces on north side). Alternatives 3.1 and 3.2 would also displace approximately one to three parking spaces from the surface parking lot located north of the Dalmasso Apartment building, and Alternative 3.5 would displace one off-street private parking space due to column placement.

In the Seattle Center Area to Fifth Avenue N, Green Line alignment Alternatives 3.1 and 3.3 are primarily located within Seattle Center. West of Seattle Center, Alternative 3.2 would displace approximately three parking spaces on the west side of Warren Avenue, and 17 to 19 off-street private parking spaces due to column placement. Alternative 3.5 would displace the Frol Building, which currently provides approximately 100 parking spaces for the Pacific Science Center. East of Seattle Center, both Alternatives 3.1.4 and 3.2 would displace five parking spaces on the west side of Fifth Avenue N due to column placement; Alternative 3.2 would also gain approximately 20 new parking spaces between columns on the east side of Fifth Avenue N. Parking losses associated with the different station alternatives in this subsegment are listed in Table 4.1-39.

All alternatives would displace some parking spaces along Fifth Avenue due to guideway column placement. Alternatives 3.1, 3.3, and 3.5 would displace approximately 59 spaces on the east side, and Alternative 3.2 would displace approximately 25 spaces on the west side of the street.

As shown in Table 4.1-39, some parking losses associated with the station alternatives are associated with new bus stops, layover facilities, or designated drop-and-drive zones. With Alternatives 3.3 and 3.5, approximately 32 off-street parking spaces would also be displaced at the Seattle Center Key Arena with the Seattle Center/Queen Anne 2 station option; and all alternatives would result in the displacement of off-street surface parking lots.

A total of 646 on-street unrestricted and 1,210 on-street restricted (by meter, time limit signs, residential parking zones, or loading zones) parking spaces are currently provided within ¼-mile radius of the station locations in the Seattle Center/Queen Anne/Belltown Segment. The majority of the parking losses in this segment would affect metered/restricted spaces along Fifth Avenue N and Fifth Avenue. However, some on-street parking losses are also expected on Harrison Street (all alternatives) and Warren Avenue (Alternative 3.2). On-street metered/restricted parking spaces located west, east, and south of Seattle Center are currently approximately 43 to 79 percent used during midday hours. Therefore, the potential parking losses shown in Table 4.1-38 are not expected to significantly affect overall parking supply in the area.

Parking Demand

On-street unrestricted parking near the station locations is currently approximately 100 percent used during the early morning and midday hours (Refer to Appendix OO of this Final EIS, Transportation Backup Information, for a more detailed discussion of existing parking supply and demand within ¼-mile radius of each Green Line station alternative). Based on these high utilization rates, there is little to no potential for additional hide-and-ride impacts. Some Green Line passengers could park in private pay lots in the vicinity of Seattle Center. However, most Green Line passengers would likely find that the parking cost, added transit transfer time, and Green Line fare would make this option cost-prohibitive.

Truck Circulation Impacts

All of the alignment alternatives in the Queen Anne/Seattle Center/Belltown Segment would cross Broad Street, which is designated as a major truck street in the City's Comprehensive Plan. In addition, Alternative 3.5 would place guideway columns along Denny Way, which is identified as a major truck street. Roadway cross-sections and vertical clearances would be maintained to ensure that these truck routes meet required design standards, and to ensure that no significant truck circulation impacts would result from any of the alternatives. Overall, Alternative 3.5 has the greatest potential for affecting truck circulation to/from businesses, followed by Alternatives 3.1 and 3.3. Alternative 3.2 has the least potential for affecting truck circulation. A more detailed discussion of each alternative follows.

Alternative 3.1 would locate guideway columns within the existing parking lane on the south side of W Harrison Street, which should minimize impacts to left or right turning movements to and from adjacent businesses and side streets. No truck circulation impacts would be expected if columns are located to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. In addition, no truck circulation impacts would be expected in the portion of the alignment between W Harrison Street and Fifth Avenue N, since the alignment would be within Seattle Center. On Fifth Avenue, new columns would be placed in the center of the street, which could prevent vehicles from passing between columns to change lanes. Columns already exist along this section of Fifth Avenue, and since trucks are not currently able to maneuver between existing columns, introduction of new columns would not likely present any change to existing truck circulation patterns along Fifth Avenue.

Alternative 3.2 would place guideway columns on the north side of W Harrison Street, on the west side of Warren Street, on the north side of Mercer Street, on the east side of Fifth Avenue N, and west of center of Fifth Avenue. On all of these streets, columns would either be placed within an existing parking lane or in the sidewalk/planter area along these streets. No truck circulation impacts would be expected if columns are located to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. Alternative 3.3 would result in the same truck circulation impacts to W Harrison Street and Fifth Avenue as Alternative 3.1. Between W Harrison Street and Fifth Avenue, the alignment would cross Seattle Center and would not likely result in any truck circulation impacts.

Alternative 3.5 would result in the same truck circulation impacts to W Harrison Street and Fifth Avenue as Alternatives 3.1 and 3.3. Alternative 3.5 would place guideway columns on the east side of Second Avenue N (supported by straddle bents) and in the eastbound curb lane of Denny Way. Few truck circulation impacts would be expected along these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. There is some potential for truck circulation impacts along Thomas Street south of Key Arena, where the guideway columns would need to be carefully placed to minimize impacts to turning movements in and out of loading docks.

Preferred Alternative

In the Queen Anne/Seattle Center/Belltown Segment, the Preferred Alternative would be a combination of the alignment alternatives evaluated for different portions of the segment. The Preferred Alternative route begins with a route similar to the Alternative 3.1 alignment along the south side of W Harrison Street and would fly over the Dalmasso Apartment Building and parking lot. The route would then continue through the Seattle Center, with the Seattle Center/Queen Anne 1A Station northwest of Key Arena. The Preferred Alternative would then travel through Seattle Center along the path of Republican Street and through the EMP (Alternative 3.1.1) and then along the center of Fifth Avenue N (Alternative 3.1.3), passing through the Seattle Center/Fifth and Broad 1A Station. Along Fifth Avenue, the Preferred

Alternative would follow the Alternative 3.2.1 alignment along the west side of the street, with the columns and guideway for the existing monorail removed, and with the Belltown 1A Station.

Table 4.1-34 summarizes the results of the p.m. peak hour level of service (LOS) analysis conducted for the different alignment segments associated with the Preferred Alternative. As shown in this table, most study area intersections would operate at LOS E or better during the p.m. peak hour in the year 2010 with the Preferred Alternative. As shown in Table 4.1-35, all intersections evaluated would operate at LOS C or better during the a.m. peak hour in the years 2010 and 2020 with the Preferred Alternative. Overall the Preferred Alternative would result in similar LOS impacts as the No Action Alternative and Alternatives 3.1, 3.2, and 3.3. Alternative 3.5 would worsen LOS along Denny Way due to the reduction of eastbound through capacity. On Fifth Avenue, the Preferred Alternative would result in slightly higher delays than all other alternatives due to the elimination of a southbound travel lane.

With regard to access and circulation, safety, and potential truck circulation impacts, placement of guideway columns within the existing parking lane on the south side of W Harrison Street, the west side of Fifth Avenue N, and the west side of Fifth Avenue, would minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to minimize impeding vehicular, pedestrian, and truck circulation at side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns. Between First Avenue N on the west side of Seattle Center and Fifth Avenue in Belltown, no vehicular access or truck circulation impacts would be expected. The Preferred Alternative would cross Broad Street, which is designated as a major truck street in the City's Comprehensive Plan; roadway cross-sections and vertical clearances would be maintained to ensure that this truck route meet required design standards, and to ensure that no significant truck circulation impacts would result. The removal of the existing monorail structure and columns in the center of Fifth Avenue would result in improved sight distance for vehicles changing lanes. Between W Harrison Street and Seattle Center, the Preferred Alternative (Alternative 3.1) would result in similar impacts as all of the other alternatives. From the Seattle Center Area to Fifth Avenue N, impacts would be greater with Alternatives 3.2 and 3.5 than with the Preferred Alternative (Alternative 3.1) and Alternative 3.3. Along Fifth Avenue in Belltown, the Preferred Alternative (same as Alternative 3.2) would result in fewer impacts than Alternatives 3.1, 3.3, and 3.5.

Table 4.1-36 summarizes the number of pedestrian trips expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B or better in the years 2010 and 2020 with the Preferred Alternative. In addition, a number of bicycle facilities currently exist within 1/2-mile radius of all stations associated with the Preferred Alternative. The SMP Board has determined to provide, at initial operations, 20 bicycle spaces at each neighborhood station and 10 spaces at each station within the Downtown Turnback. Table 4.1-37 summarizes the longer-term space allocation proposed for bicycle storage at each Green Line station if bicycle demand increases.

A net loss of approximately 116 to 118 parking spaces is expected to result from the Preferred Alternative. A breakdown of these losses is shown in Tables 4.1-38 and 4.1-39 and are summarized below for the various subsegments associated with the Preferred Alternative:

- From W Harrison Street to the Seattle Center, the Preferred Alternative (similar to the Alternative 3.1 alignment) would displace approximately 10 parking spaces on the south side of W Harrison Street and would displace one to three off-street parking spaces in the surface parking lot located north of the Dalmasso Apartment Building. Parking losses in this subsegment are similar to all other alternatives.
- Between the Seattle Center area and Fifth Avenue N, the Preferred Alternative (similar to Alternative 3.1.4) would displace five on-street parking spaces on the west side of Fifth Avenue N. The Seattle

Center/Queen Anne 1A Station would displace approximately 3 on-street parking spaces on Republican Street to provide a drop-and-drive zone. The Seattle Center/Fifth and Broad 1A Station would displace two on-street parking spaces on John Street and two on-street parking spaces between John Street and Broad Street to provide drop-and-drive zones, and would displace approximately 68 off-street parking spaces in the Space Needle surface parking lot. Parking losses associated with the Preferred Alternative (3.1.4) in this subsegment would be lower than Alternatives 3.2.3, 3.3, and 3.5 but higher than Alternatives 3.1 and 3.2.

- South of Denny Way, the Preferred Alternative (Alternative 3.2) would displace approximately 25 on-street parking spaces on the west side of Fifth Avenue due to column placement. No parking spaces would be displaced with the Belltown 1A Station. Parking losses associated with the Preferred Alternative in this subsegment would be lower than Alternatives 3.1, 3.3, and 3.5.

These parking losses would not result in significant impacts to existing parking supply, since a total of 646 on-street unrestricted and 1,210 on-street restricted parking spaces are currently provided within ¼-mile radius of the station locations. There is little to no potential for hide-and-ride parking impacts in the Seattle Center/Queen Anne/Belltown Segment, since parking is currently approximately 100 percent used during the early morning and midday hours.

Downtown/Pioneer Square Segment

All Green Line alternatives were assumed to eliminate a westbound travel lane on Stewart Street to accommodate the new guideway. Parking would be eliminated from both sides of the street, and it was assumed that time-limited parking would be provided between guideway columns between Fourth and Fifth Avenues. On Second Avenue, the primary differences assumed between the alternatives are in which side of the street passenger loading would occur and where on-street parking would be provided or eliminated. A bus-only lane and three general-purpose travel lanes would be provided with the No Action and all Green Line alternatives.

The analysis of Alternative 4.1 assumed that parking would be eliminated from the east side of the street and that off-peak parking would be provided between columns on the west side of the street. The Alternative 4.2 analysis assumed that on-street parking would be provided between columns on the east side of the street north of Marion Street; south of Marion Street, on-street parking would be provided between guideway columns on the west side of the street, and on-street parking on the east side of the street would be removed. The Alternative 4.3 analysis assumed that the monorail columns would be placed in the center of Second Avenue, and that all on-street parking would be removed to maintain three general-purpose lanes and one bus-only lane. Alternative 4.3 was also assumed to remove an existing bicycle lane on the east side of Second Avenue. Alternative 4.4 would place guideway columns 11 feet east of the Alternative 4.3 alignment, retaining one travel lane and a bicycle lane east of the guideway. The cross-sections assumed for each alternative would maintain existing lane widths.

Traffic Volumes and Level of Service

Table 4.1-40 summarizes the LOS evaluation results for weekday p.m. peak hour conditions in the years 2010 and 2020 with the No Action Alternative and three Green Line alternatives in the Downtown/Pioneer Square Segment. For Alternative 4.1, two station alternatives are being evaluated for both the Fifth and Stewart and Pike stations. The different station alternatives would result in very similar traffic impacts and therefore were not evaluated separately for Alternative 4.1.

**Table 4.1-40. Downtown/Pioneer Square Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	Year 2010					Year 2020				
		No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4	No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4
Fifth Avenue/ Lenora Street	B (13.8)	B (14.9)	C (30.4)^a	B (15.0)	B (15.0)	B (15.0)	B (15.6)	D (43.4)^a	B (15.7)	B (15.7)	B (15.7)
Fifth Avenue/ Virginia Street	B (14.3)	B (15.0)	C (23.9)^a	B (15.2)	B (15.2)	B (15.2)	B (15.8)	C (30.8)^a	B (15.8)	B (15.8)	B (15.8)
Fifth Avenue/ Stewart Street	B (13.9)	B (14.3)	D (40.2)	D (40.2)	D (40.2)	D (40.2)	B (15.7)	D (41.7)	D (41.7)	D (41.7)	D (41.7)
Fourth Avenue/ Stewart Street	B (18.5)	C (20.4)	C (21.6)	C (21.6)	C (21.6)	C (21.6)	C (24.6)	C (25.5)	C (25.7)	C (25.7)	C (25.7)
Third Avenue/ Stewart Street	B (18.9)	B (19.0)	C (20.1)	C (20.1)	C (20.1)	C (20.1)	B (19.3)	C (20.9)	C (21.1)	C (21.0)	C (21.0)
Second Avenue/ Stewart Street	B (11.5)	B (12.0)	B (12.4)	B (12.5)	B (12.4)	B (12.4)	B (11.3)	B (12.7)	B (13.2)	B (13.2)	B (13.2)
Second Avenue/ Pine Street	A (7.8)	A (7.8)	A (8.1)	A (8.1)	A (8.1)	A (8.1)	A (8.2)	A (8.4)	A (8.6)	A (8.6)	A (8.6)
Second Avenue/ Pike Street	B (12.7)	B (13.8)	B (12.5)	B (12.1)	B (11.8)	B (11.8)	B (15.8)	B (14.0)	B (13.4)	B (13.0)	B (13.0)
Second Avenue/ Union Street	B (10.8)	B (11.4)	B (11.5)	B (11.4)	B (11.4)	B (11.4)	B (12.2)	B (12.2)	B (12.0)	B (11.9)	B (11.9)
Second Avenue/ University Street	A (8.1)	A (8.2)	A (8.9)	A (8.8)	A (8.9)	A (8.9)	A (8.9)	A (9.3)	A (9.4)	A (9.5)	A (9.5)
Second Avenue/ Seneca Street	B (10.6)	B (11.0)	B (11.0)	B (11.1)	B (11.0)	B (11.0)	B (11.8)	B (11.7)	B (11.9)	B (11.7)	B (11.7)
Second Avenue/ Spring Street	B (12.9)	B (13.8)	B (13.7)	B (13.7)	B (13.7)	B (13.7)	B (14.0)	B (13.9)	B (13.9)	B (13.9)	B (13.9)
Second Avenue/ Madison Street	B (16.6)	B (17.0)	B (16.7)	B (17.3)	B (16.8)	B (16.8)	B (17.5)	B (17.4)	B (17.8)	B (17.3)	B (17.3)
Second Avenue/ Marion Street	A (6.8)	A (6. 9)	A (7.2)	A (6.8)	A (6.8)	A (6.8)	A (6.9)	A (6.8)	A (6.8)	A (6.8)	A (6.8)
Second Avenue/ Columbia Street	E (75.0) ^b	F (84.6) ^b	F (84.3)^g	F (83.9) ^g	E (72.1) ^g	E (72.1) ^g	F (97.5) ^g	F (97.1)^g	F (96.7) ^g	F (85.5) ^g	F (85.5) ^g
Second Avenue/ Cherry Street	A (6.8)	A (6.6)	A (6.8)	A (6.6)	A (6.7)	A (6.7)	A (6.7)	A (6.7)	A (6.6)	A (6.7)	A (6.7)

**Table 4.1-40. Downtown Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives (continued)**

Intersection	Existing	Year 2010					Year 2020				
		No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4	No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4
Second Avenue/ James Street	C (28.0)	D (36.2)	D (35.8)	D (35.8)	C (28.2)	C (28.2)	D (42.0)	D (41.9)	D (41.9)	C (33.5)	C (33.5)
Second Avenue/ Yesler Way	B (17.1)	B (18.6)	B (18.3)	B (18.4)	B (18.3)	B (18.3)	B (19.5)	B (19.5)	B (19.1)	B (19.0)	B (19.0)
Second Avenue Ext./ S Washington Street	C (20.3)	B (19.7)	B (19.7)	B (19.7)	C (20.4)	C (20.4)	B (19.2)	B (19.2)	B (19.1)	B (19.9)	B (19.9)
Second Avenue/ S Washington Street	B (12.6)	B (12.7)	B (12.7)	B (12.8)	B (12.7)	B (12.7)	B (12.7)	B (12.7)	B (12.7)	B (12.7)	B (12.7)
Second Avenue Ext./ S Main Street	C (32.1)	C (33.6)	C (32.5)	C (33.9)	C (32.7)	C (32.7)	C (34.3)	C (33.3)	C (34.8)	C (33.3)	C (33.3)

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

^a Assumes that two travel lanes would be provided on Fifth Avenue to accommodate the west of center monorail guideway alignment.

^b This intersection is shown operating at LOS E/F due to the conservatively high assumption that all bus trips would be added to the high southbound right-turn movement in a right-turn only lane. If the southbound approach were evaluated with four through lanes and bus volumes coded as through movements, the Second Avenue/Columbia Street intersection would operate at an acceptable LOS D for all alternatives.

LOS Estimates for Preferred Alternative are presented in bold type.

Along Stewart Street, all Green Line alignment alternatives would eliminate a westbound travel lane to accommodate the guideway. On Second Avenue, the primary differences among the alternatives are in which side of the street passenger loading would occur and where on-street parking would be provided or eliminated, both of which are relatively minor factors in determining average intersection delay. A bus lane would also be provided on the west side of Second Avenue with the No Action Alternative and all Green Line alternatives. Since the Synchro software program does not model bus-only lanes, a conservative analysis was conducted, assuming that bus volumes would be combined with right turn volumes in a right-turn only lane. Where right turns currently are not allowed, bus traffic was added to through traffic on the remaining three travel lanes and the bus-only lane removed from the intersection cross-section. Alternatives 4.3 and 4.4 would also provide the guideway in a center median, which would affect access and circulation and traffic safety along Second Avenue. This median also could not be modeled in Synchro. In general, however, the weaving restrictions associated with center alignments on one-way streets reduces the effective capacity of the remaining travel lanes, because drivers must choose the lanes that will allow the local access or turning movement associated with their trip. This indirect impact exists even without weaving restrictions, particularly during the peak period when high traffic volumes make it more difficult to weave between travel lanes.

Individual peak hour turning movements at the study intersections vary by no more than 30 vehicles per hour among the alternatives, which is a small percent of overall intersection traffic.

As shown in Table 4.1-40, there is little difference in projected intersection delays among the different alternatives for both years 2010 or 2020, and no significant level of service changes. All intersections evaluated would operate at LOS D or better in the years 2010 and 2020 with the No Action and Green Line Alternatives, with the exception of the Second Avenue/Columbia Street intersection which would operate at LOS F with most alternatives in the year 2010 and all alternatives in year 2020. This LOS F condition results from the conservative assumption that all bus trips would make a right turn from a right-turn only lane, along with the high volume of southbound right turn movements accessing SR 99 from Columbia Street. If the southbound approach were instead coded with four through lanes, the Second Avenue/Columbia Street intersection would operate at LOS D with the No Action and all Green Line alternatives in the years 2010 and 2020. The Fifth Avenue/Stewart Street intersection would change from LOS B with the No Action Alternative to LOS D with all Green Line alternatives in the years 2010 and 2020 with the removal of a westbound through lane. While overall LOS would remain acceptable with this capacity reduction, LOS for the westbound approach would change from LOS B with the No Action Alternative to LOS F with the Green Line alternatives in the years 2010 and 2020.

Table 4.1-41 summarizes the a.m. peak hour analysis results for three key study intersections identified for analysis. As shown in Table 4.1-41, year 2010 and 2020 a.m. peak hour traffic operations are comparable to p.m. peak hour conditions at the intersections selected for a.m. analysis. All three intersections currently operate and would continue to operate with lower delays during the a.m. peak hour than during the p.m. peak hour with the No Action and Green Line Alternatives.

Access and Circulation

Property access impacts in the Downtown/Pioneer Square Segment differ for each alignment alternative, depending on the location of the guideway within the Stewart Street and Second Avenue rights-of-way. Alternatives 4.3 and 4.4, which would place the guideway in the center or east of center on Second Avenue, introduce the greatest potential for access and circulation impacts. Alternatives 4.1 and 4.2 would result in the least potential for access and circulation impacts. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis.

**Table 4.1-41. Downtown/Pioneer Square Segment: a.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	Year 2010					Year 2020				
		No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4	No Action	Alt. 4.1	Alt. 4.2	Alt. 4.3	Alt. 4.4
Fifth Avenue/ Stewart Street	B (12.4)	B (12.7)	B (13.9)	B (13.8)	B (13.8)	B (13.8)	B (13.4)	B (15.1)	B (15.1)	B (15.1)	B (15.1)
Second Avenue/ Stewart Street	B (14.6)	B (17.1)	C (31.1)	C (31.1)	C (30.3)	C (30.3)	B (16.0)	D (38.9)	D (38.9)	D (38.1)	D (38.1)
Second Avenue/ Pike Street	A (7.2)	A (7.6)	A (8.1)	A (8.1)	A (8.0)	A (8.0)	A (7.6)	A (8.7)	A (8.8)	A (8.6)	A (8.6)

Source: Parametrix, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

LOS estimates for Preferred Alternative are presented in bold type.

Alternative 4.1 would locate guideway columns on the south side of Stewart Street, on private property, within the center planter area, and in an existing parking area on the south side of the street. One lane of traffic would be eliminated on Stewart Street. No vehicular access and circulation impacts would be expected in this section of the alignment. On Second Avenue, guideway columns would be placed in the existing bus/off-peak parking lane on the west side of the street. Off-peak parking would be provided between columns and the bus-only lane would shift one lane to the east of the guideway columns. With this configuration, some vehicles accessing the new parking spaces between columns would be required to cross the bus-only lane during off-peak periods.

Alternative 4.2, similar to Alternative 4.1, would place the guideway columns on the south side of Stewart Street, resulting in no vehicular access and circulation impacts. On Second Avenue between Stewart Street and Marion Street, Alternative 4.2 would place guideway columns in the eastern parking lane with no impact to vehicular access and circulation. South of Marion Street, the Alternative 4.2 alignment would shift to the west side of the street and continue south with the same configuration and access and circulation impacts as Alternative 4.1. In the transition area between approximately Marion Street and Cherry Street, the guideway would be supported by straddle bents on both sides of Second Avenue. The sidewalk on the west side of street would likely be narrowed from its existing 18-foot width to 10 feet in this transition area.

As with Alternatives 4.1 and 4.2, Alternatives 4.3 and 4.4 would place guideway columns on the south side of Stewart Street, resulting in no vehicular access and circulation impacts. On Second Avenue, the guideway columns associated with Alternatives 4.3 and 4.4 would be placed in the center or east of the center of the street. Vehicles would likely be prohibited from passing between columns to change lanes because the Seattle Department of Transportation would require a median, which could result in some vehicles changing lanes at signalized intersections and/or some out-of-direction travel for drivers to reach their destinations. With Alternative 4.3, center station platforms along Second Avenue would require additional straddle bents to support the station structure. In these locations, sidewalks on both sides of Second Avenue would be narrowed from existing 18-foot widths to approximately 10 feet.

With all alternatives, columns could in almost all instances be placed to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Traffic Safety

Traffic safety impacts in the Downtown/Pioneer Square Segment are primarily caused by the introduction of guideway columns in public right-of-way. Alternatives 4.3 and 4.4 would likely result in the greatest potential for traffic safety impacts, followed by Alternative 4.2 and Alternative 4.1.

For all alignment alternatives, columns on Stewart Street would be placed in sidewalks, private property, and planter areas to minimize impeding vehicular or pedestrian flow, and to provide adequate sight distance around the columns.

With Alternative 4.1 and a portion of Alternative 4.2, columns would be placed in the existing bus/off-peak parking lane on the west side of Second Avenue. Off-peak parking could be provided between columns and the bus-only lane would shift one lane to the east of the columns. With this configuration, vehicles could be required to cross the bus-only lane to access the new parking spaces, which could result in some auto/bus conflicts during off-peak time periods when parking would be allowed on this side of the street. For Alternative 4.2, this potential traffic safety impact would only occur south of Marion Street. With Alternative 4.2, there is also some increased potential for traffic safety impacts in the area between approximately Marion Street and Cherry Street, where the guideway would transition from the east side of Second Avenue to the west side. In this section of Second Avenue, there would be some shifting of travel lanes through and between intersections.

Alternatives 4.3 and 4.4 would place guideway columns in the center or east of center on Second Avenue. Vehicles could be prohibited from passing between columns to change lanes. This could result in driver confusion and create some potential for new accidents, as vehicles attempt to change lanes through signalized intersections.

The Green Line would result in increases in bicycle, and pedestrian activity in the vicinities of the station alternatives. These stations would be designed to provide safe and convenient access for all modes. The potential addition of a new grade-separated pedestrian walkway between the Fifth and Stewart station and Westlake Center (Alternatives 1, 1A, 2, and 2A) would improve pedestrian safety along the alignment.

Pedestrian and Bicycle Facility Impacts

Sidewalks and crosswalks throughout Downtown Seattle currently experience high volumes of pedestrian traffic. Most of the streets within the Downtown/Pioneer Square Segment have sidewalks and all signal-controlled intersections have pedestrian crosswalks. There are mid-block pedestrian signals on Fifth and Fourth Avenues. The existing sidewalk network would provide pedestrians a safe and convenient way to travel to the Green Line stations. All the pedestrian crossings and intersections near the station alternatives have curb ramps. Table 4.1-42 summarizes the number of pedestrian trips expected at each station.

All sidewalks evaluated near the Green Line station alternatives currently operate at LOS B or better. With the No Action Alternative and all the Green Line alignment and station alternatives, sidewalks would continue to operate at LOS B or better in the year 2010 and year 2020. The current sidewalk width along Second Avenue is 18 feet. With Alternative 4.2, the existing sidewalk on the west side of Second Avenue would be narrowed to 10 feet to accommodate straddle bents required in the transition area between approximately Marion Street and Cherry Street. With Alternative 4.3, the existing 18-foot sidewalks on Second Avenue would be narrowed to 10 feet near the station to accommodate straddle bent columns required to support the station platform in the center of Second Avenue. Even with these reduced widths, all sidewalks along Second Avenue are expected to operate at LOS B or better.

Table 4.1-42. Downtown/Pioneer Square Segment: Nonmotorized Facility Impact Summary

Station Name and Alternative	2020 p.m. Peak Hour Walk Trips	
	Ingress	Egress
Fifth and Stewart 1, 1A, 2, and 2A, Lenora 3	462	227
Pike 1, 2, 2A, and 3	280	136
Madison 1, 2, 2A, and 3	294	123
Yesler 1 and 2	311	169

A southbound bicycle lane is provided on Second Avenue, extending from Belltown to Main Street in SODO. In addition, paved trails exist along the waterfront and within Myrtle Edwards Park. These bicycle facilities would provide Green Line passengers access to the neighborhoods north and south of Downtown Seattle, and would provide them an alternative to either walk or use transit to travel to and from Green Line stations.

With Alternative 4.3, the Second Avenue bicycle lane was assumed to be removed between Stewart Street and S Washington Street, and a new lane is not currently proposed to replace this lane. The existing bicycle lane provides bicyclists a connection to Downtown Seattle from adjacent neighborhoods. Mitigation for the removal of this bicycle lane would need to be identified, and could include the option of removing a southbound travel lane. This strategy is discussed in further detail in Section 4.1.3, Mitigation. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. In addition to parking spaces at Downtown Green Line stations, existing bicycle facilities and services provided in the Downtown area could be used by Green Line patrons including Bikestation Seattle, located near the Third Avenue S/S Main Street/Yesler Way intersection in Pioneer Square.

Parking Impacts

Parking Supply

The Green Line alignment and station alternatives in the Downtown/Pioneer Square Segment would result in a net loss of 466 to 1,240 parking spaces. These include a combination of on- and off-street parking losses associated with column placement, and off-street parking losses due to property takes for station facilities. These losses to existing parking supply are summarized by alignment alternative in Table 4.1-43. Table 4.1-44 summarizes the parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of the Final EIS. The parking losses shown in Table 4.1-44 for each proposed station alternative are accounted for in the total parking losses summarized in Table 4.1-43.

As shown in Table 4.1-43, Alternative 4.3 (Center of Second) would result in the highest net parking loss. Alternatives 4.4 (East Center of Second), 4.2 (East of Second/Crossover) and 4.1 (West Side of Second) would result in nearly 50 percent or fewer parking losses than Alternative 4.3. All alternatives would displace approximately eight metered parking spaces on Stewart Street between Second Avenue and Fifth Avenue. All alignment alternatives would also displace metered parking on Second Avenue between Stewart Street and Jackson Street. Alternative 4.1, which would locate the columns on the west side of Second Avenue, would displace off-peak metered parking on the west side of the street and was assumed to provide new off-peak parking between columns; all on-street metered parking on the east side of the street would also be displaced to maintain three general-purpose travel lanes. Between Stewart Street and Marion Street, Alternative 4.2 would displace all on-street metered parking on the east side of street and would provide new off-peak parking between columns; south of Marion Street, Alternative 4.2 would

follow the same alignment as Alternative 4.1. Alternatives 4.3 and 4.4 would displace all on-street metered parking on the west and east sides of Second Avenue. Alternative 4.1 would also displace several off-street parking spaces due to column placement near the Second Avenue/Stewart Street intersection and near S Jackson Street, and Alternative 4.2 would displace several surface parking lots on Fifth Avenue, Second Avenue, and Pine Street. Alternative 4.3 would displace the Bon Marche parking garage, which currently supplies approximately 554 off-street parking spaces, as well as several other surface parking lots on Fourth Avenue, Pine Street, and Second Avenue due to column placement. The Alternative 4.4 guideway would displace off-street parking spaces from two surface parking lots along Second Avenue, and a few parking spaces from off-street property near S Jackson Street.

Table 4.1-43. Downtown/Pioneer Square Segment: Total Parking Losses – By Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement		Parking Losses at Station Alternatives ^b		Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street	
4.1 – West Side of Second	185	7	0	275 to 352	467 to 544
<i>4.1.1 – Route to Fifth and Stewart (Northwest)</i>	<i>185</i>	<i>7</i>	<i>0</i>	<i>301 to 352</i>	<i>493 to 544</i>
<i>4.1.2 – Route to Fifth and Stewart (Virginia)</i>	<i>185</i>	<i>7</i>	<i>0</i>	<i>275 to 326</i>	<i>467 to 518</i>
4.2 – East of Second/Crossover	122	116	0	384	622
4.3 – Center of Second	236	643	0	300 to 361	1,179 to 1,240
4.4 – East Center of Second	236	63	0	384	683

^a Parking impacts shown are permanent displacements due to guideway column placement, bus zones, drop-and-drive areas, and partial property takes associated with different alignment and station alternatives.

^b See Table 4.1-44 for a detailed breakdown of these potential parking losses.

Impacts for Preferred Alternative are presented in bold type.

As shown in Table 4.1-44, the Yesler station alternatives (associated with all alignment alternatives) would displace the Sinking Ship Garage, which would result in a loss of 245 off-street parking spaces. Several other surface parking lots would be displaced with the Fifth and Stewart, Lenora, and Pike station alternatives.

On-street metered/restricted parking is currently fully utilized during most periods of the day. In addition, a large number of off-street parking spaces would be displaced by the alignment and station alternatives. Therefore, the parking losses shown in Table 4.1-43 could be considered significant.

Parking Demand

On-street parking near the station alternatives in the Downtown/Pioneer Square Segment is primarily restricted by parking meters between 8:00 a.m. and 6:00 p.m. Because of this, there is little potential for hide-and-ride impacts. Some parking impacts could also occur in private pay lots. However, most Green Line passengers would likely find that high parking costs and good transit connections would make this option unappealing.

Table 4.1-44. Downtown/Pioneer Square Segment: Losses at Station Alternatives^a

Station	Spaces Displaced	Area Affected by Displacement
Fifth and Stewart 1 (Alt. 4.1.1)	51	Avis Parking Garage (25 spaces), surface parking lot on Fifth Avenue (26 spaces)
Fifth and Stewart 1A (Alt. 4.1.1)	0	None
Fifth and Stewart 2 (Alt. 4.1.2, 4.3)	25	Avis Parking Garage (25 spaces)
Fifth and Stewart 2A (Alt. 4.1.2)	0	None
Lenora 3 (Alts. 4.2, 4.3, and 4.4)	86	Surface parking lots on Fifth Avenue (61 and 25 spaces)
Pike 1A (Alt. 4.1)	30	Surface parking lot on Second Avenue (30 spaces)
Pike 1B (Alt. 4.1)	56	Surface parking lot on Second Avenue (30 spaces) and First Avenue (26 spaces)
Pike 2 (Alt. 4.2)	53	Surface parking lot on Second Avenue (53 spaces)
Pike 2A (Alt. 4.4)	53	Surface parking lot on Second Avenue (53 spaces)
Pike 3 (Alt. 4.3)	30	Surface parking lot on Second Avenue (30 spaces)
Madison 1, 2, 2A and 3 (Alts. 4.1, 4.2, 4.3, and 4.4)	0	None
Yesler 1 (Alts 4.1, 4.2 and 4.4)	245	Sinking Ship Garage (245 spaces)
Yesler 2 (Alts. 4.3 and 4.4)	245	Sinking Ship Garage (245 spaces)

^a Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. Parking losses identified are all full property takes associated with the station alternatives.

Truck Circulation Impacts

None of the alignment alternatives in the Downtown/Pioneer Square Segment would cross any major truck streets, and no significant truck circulation impacts would result from any of the alternatives. Of all alternatives, Alternatives 4.3 and 4.4 have the greatest potential for truck circulation impacts, since the guideway would be located in the center of Second Avenue. A more detailed discussion of each alternative follows.

With Alternatives 4.1 and 4.2, guideway columns would be placed on the south side of Stewart Street, on private property, within the center planter area, and in an existing parking area on the south side of the street. One travel lane would be eliminated on Stewart Street. Guideway columns would be placed in the existing bus/off-peak parking lane on the west side of Second Avenue with Alternative 4.1 and with Alternative 4.2 south of Marion Street. North of Marion Street, Alternative 4.2 would place guideway columns in the eastern parking lane. Off-peak parking would be provided between columns and the bus-only lane would shift one lane to the east of the columns. No truck circulation impacts would be expected along either of these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks.

Alternatives 4.3 and 4.4, like Alternatives 4.1 and 4.2, would place guideway columns on the south side of Stewart Street, resulting in little to no truck circulation impacts. On Second Avenue, the guideway columns associated with Alternatives 4.3 and 4.4 would be placed in the center or east of the center of the street, which could prevent trucks and all other vehicles from passing between columns to change lanes. This could result in some trucks changing lanes at signalized intersections and/or some out-of-direction travel for trucks to reach their destinations.

Preferred Alternative

In the Downtown/Pioneer Square Segment, the Alternative 4.1 alignment, with the Fifth and Stewart 2A, Pike 1B, Madison 1, and Yesler 1 Stations is the Preferred Alternative. As with all other alignment alternatives, a westbound travel lane would be removed from Stewart Street to accommodate the Green

Line guideway on the south side of the street. On Second Avenue, the Green Line guideway would be located on the west side of the street.

Table 4.1-40 summarizes the results of the p.m. peak hour level of service (LOS) analysis conducted for Alternative 4.1. As shown in this table, most study area intersections would operate at LOS D or better in the years 2010 and 2020 with the Preferred Alternative. The only exception is the Second Avenue/Columbia Street intersection, which would operate at LOS F in the years 2010 and 2020 with the No Action and Preferred Alternatives due to a high volume southbound right turn movements accessing SR 99 from Columbia Street. Table 4.1-41 summarizes the results of the a.m. peak hour LOS analysis. As shown in Table 4.1-41, all intersections evaluated would operate at LOS C or better during the a.m. peak hour in the years 2010 and 2020 with the Preferred Alternative. Overall, the Preferred Alternative would result in similar LOS and delays as all other alternatives in Segment 4. The only exception is at the Fifth Avenue/Lenora Street intersection, which would operate at LOS D in the year 2020 due to the reduction of southbound through capacity on Fifth Avenue.

Placement of Green Line guideway columns on the south side of Stewart Street would not result in any vehicular access and circulation, traffic safety, or truck circulation impacts. On Second Avenue, guideway columns would be placed in the existing bus/off-peak parking lane on the west side of the street. Off-peak parking would be provided between columns and the bus-only lane would shift one lane to the east of the guideway columns. With this configuration, vehicles could be required to cross the bus-only lane to access the new parking spaces, which could result in some auto/bus conflicts. No truck circulation impacts would be expected along either of these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. Overall, the Preferred Alternative would result in fewer access and circulation, safety, and truck circulation impacts than Alternatives 4.3, and 4.4. Alternative 4.2 would result in similar access and circulation and truck circulation impacts as the Preferred Alternative, but would have a slightly greater potential for safety impacts.

Table 4.1-42 summarizes the number of pedestrian trips expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B or better in the years 2010 and 2020 with the Preferred Alternative. Ten bicycle parking spaces would be provided at each Green Line station in the Downtown/Pioneer Square Segment. In addition, a number of bicycle facilities currently exist within 1/2-mile radius of all stations associated with the Preferred Alternative.

A net loss of up to 492 (185 on-street, 307 off-street) parking spaces is expected to result from the Preferred Alternative. A breakdown of parking losses is shown in Tables 4.1-43 and 4.1-44 for the Alternative 4.1.2 alignment and the different station alternatives associated with the Preferred Alternative. Most of these parking spaces would be off-street garage or surface lots replaced by stations (301). Along Stewart Street, approximately eight on-street parking spaces between Second Avenue and Fifth Avenue would be displaced. The Preferred Alternative would also displace a total of approximately 177 parking spaces from both sides of Second Avenue, and up to six off-street parking spaces on private property. Stations associated with the Preferred Alternative would also displace several off-street parking lots along Fifth Avenue, Second Avenue, and First Avenue. This includes a loss of approximately 56 off-street parking spaces with the Pike 1B Station, and approximately 245 parking spaces from the Sinking Ship Garage with the Yesler 1 Station. On-street metered/restricted parking is currently fully utilized during most periods of the day. Therefore, the relatively large number of on-and-off-street parking spaces displaced by the Preferred Alternative would cause an impact. Overall, the Preferred Alternative would result in fewer parking losses than Alternatives 4.2, 4.3, and 4.4.

Second Avenue Alternatives and Refinements

The EIS alignments for Second Avenue responded to a number of factors including the number of historic resources along that street, the desire to avoid significant impacts to the major utilities (electrical duct banks, sewer line, and water main), the desire to maintain three general purpose travel lanes, the difficulty of relocating the existing bike lane, and community urban design concerns, in particular the competing concerns of reducing the bulkiness of structures in the right-of-way while maintaining appropriate design clearances from buildings.

The Preferred Alternative 4.1 (West) and three other alternatives are analyzed in detail above. Alternative 4.1 (West) was selected as the Preferred Alternative for a number of reasons, including better transit connections, less impacts on public spaces, and station proximities to key ridership locations.

Four alternatives are studied in detail for Second Avenue. All alternatives would replace a parking lane along Second Avenue. Alternative 4.1 (West) would retain a bus lane, three general purpose travel lanes, and a bike lane along Second Avenue. Alternative 4.2 (East) would similarly retain a bus lane, three general purpose travel lanes and a bike lane. Alternative 4.3 (Center) would also retain a bus lane and three general purpose travel lanes, but would require removal of the bike lane, which is the only bike lane in this portion of downtown and would be difficult to relocate. Alternative 4.4 (East of Center) would locate the guideway in a median strip with a general purpose lane and bike lane to the east of the median and with two general purpose lanes and a bus lane to the west of those columns.

In response to urban design concerns from the community, a number of design refinements for a west side alternative have been explored and considered with the City and the community. The primary issue addressed has been the tradeoff of All of these refinements are within the range of EIS alternatives discussed in detail and within the range of impacts of those alternatives. The design discussions have focused the proximity of monorail cars to buildings. Although no significant impacts to buildings are anticipated, other than visual impacts to historic buildings, more room between trains and building might be a preferable urban design refinement. One design refinement for Alternative 4.1 (West) would be simply offsetting guidebeams on columns, which would move trains several feet further into the right-of-way. The design tradeoff would be larger column size (from the estimated range of four to five feet in diameter to six to six and a half feet in diameter) and larger foundation requirements.

Some commenters suggested removing the bike lane from Second Avenue, and then moving the monorail guideway columns five feet further to the west, thus giving more room between buildings on the west side of Second Avenue. Because the Alternative 4.1 (West) columns are placed so as to avoid the main electrical duct bank for this portion of downtown, which runs through the western portion of Second Avenue. The suggested “five feet further” refinement would locate columns over that electrical duct bank. Moving the duct bank would have significant construction impacts because relocation would take many years and would dramatically increase project and community costs. Foundations spanning the duct bank are likely infeasible because of Seattle City Light access needs. Construction impacts for those columns would be similar to Alternative 4.3 (Center). This refinement would also remove the bike lane (similar to Alternative 4.3). As noted above, that bike lane is the only one currently in the downtown area and would be difficult to relocate.

Another suggested refinement would isolate the bus lane on the west side of Second, and place columns in an undivided median (similar to Alternative 4.4 – East of Center). For operational reasons (the need for room to pass), buses could not be confined to a single lane width so a double lane would be required. This refinement would locate monorail columns just to the east of the large electrical duct bank, avoiding that major utility relocation impact. With that location, it would also be able to avoid the major Metro sewer facility under the middle of Second Avenue. Monorail columns would be located in an undivided

median similar to Alternative 4.3 (Center) and 4.4 (East of Center). This refinement would slightly decrease west sidewalk width in order to provide a bus/passing lane of 20 feet or more on the west side of the street – just west of the undivided median. Three general purpose lanes could be located in the remainder of Second Avenue – just east of the undivided median. The easternmost lane could be multi-programmable, with option to use for parking, bicycles, or general traffic at different times of the day. Station locations would be identical to Alternative 4.1 (West), with station platforms over the sidewalk similar to Alternative 4.4. Traffic impacts would be similar to Alternative 4.3 (Center), with right turns potentially restricted during peak bus hours. The multi-programmable lane would give the opportunity for bicycle use during some periods of the day and general traffic during peak traffic times as determined by the City of Seattle.

Another potential refinement would locate the guideway columns just to the east of the electrical duct bank and expand the sidewalk out to that column location. Column location would be similar to the bus/passing lane discussed above, but no undivided median would be required because the columns would be located in the sidewalk similar to Alternative 4.1(West). This configuration would result in a west sidewalk approximately 40 feet in width (see Appendix LL at page LL-340 for conceptual cross-section). This refinement would eliminate a general purpose traffic lane, and only a bus lane and two general purpose lanes would remain in the Second Avenue street cross-section. It might be possible to locate a “low-intensity” bicycle lane in the wide west sidewalk. Such options as rough paving and specific pedestrian crossing could be used to control pedestrian/bicycle conflicts, but the usefulness of that bike lane would be curtailed. Although the loss of a general purpose traffic lane would decrease overall potential capacity on Second Avenue, the street could still operate at an acceptable level of service as shown in Table 4.1-57, which is located on page 4-117.

SODO/Chinatown International District/Pioneer Square Segment

For analysis purposes, Alternative 5.1 assumed that guideway columns would be located on the east side of Third Avenue S, displacing on-street parking between S Royal Brougham Way and S Stacy Street. The Alternative 5.1 alignment would also be located on the north side of S Lander Street, on the west side of either Utah Avenue S (Alternative 5.1.1) or First Avenue S (Alternative 5.1.2), and on the north side of S Horton Street. On S Lander Street and Utah Avenue S, the guideway columns would be placed in an existing parking or loading lane. On First Avenue S, the guideway columns would be placed in an existing parking lane that is time-restricted during the p.m. peak period and used as a travel lane. For analysis purposes, the cross section for Third Avenue S assumed that 10.5-foot travel lanes and a seven-foot parking lane would be provided. On First Avenue S, the lane widths assumed are generally consistent with existing conditions.

The Alternative 5.2 or 5.2(s) alignment was assumed to locate guideway columns on the west side of Third Avenue S, displacing on-street parking between S Royal Brougham Way and S Stacy Street. Similar to Alternative 5.1.1, guideway columns would also be placed on the west side of Utah Avenue S but on the north side of S Horton Street. As with Alternative 5.1.1, the guideway columns would be placed in an existing parking or loading lane on these streets. All cross sections assumed for these roadways would meet existing conditions.

Traffic Volumes and Level of Service

Table 4.1-45 summarizes the 2010 and 2020 No Action and Green Line p.m. peak hour level of service analysis results for the SODO/Chinatown International District/Pioneer Square Segment. The Safeco Field area of the segment has just one alignment and station alternative, whereas the S Lander Street area has several different alternatives.

The results for Alternative 5.1 (East side of Third/Utah) are summarized in Table 4.1-45, and represent Alignment 5.1.1, with the Green Line traveling down the west side of Utah Avenue S. This alternative

also includes the Lander 1 (Northeast) station alternative, with the station located on the northeast corner of First Avenue S and S Lander Street.

The results for Alternative 5.2 (West side of Third/Utah) and 5.2(s) (West side of Third/Utah with single beam) are summarized in Table 4.1-45, and represent the refined diagonal alternative and the refined Lander 3 (Diagonal) station alternative.

Alternative 5.1.1 (West side of Utah Avenue S) was also evaluated with the Lander 4 (Utah) station alternative, located on the southwest corner of Utah Avenue S and S Lander Street. Alignment 5.1.2 (west side of First Avenue S) was evaluated with the Lander 2 (Southwest) station, located on the southwest corner of First Avenue S and S Lander Street. The LOS analysis with these station alternatives resulted in vehicle delays within 0.5-second of the results shown in Table 4.1-45.

Intersection operation during the p.m. peak hour is expected to remain at LOS E or above at all the intersections in the No Action and Green Line Alternatives, with the exception of the Fourth Avenue S/S Royal Brougham Way intersection. This intersection is forecast to operate at LOS F in the No Action Alternative (in both the 2010 and 2020 horizon years), and would operate at LOS F with approximately 1 second of additional delay as a result of the Green Line. Operations at this location may improve when Phase 2 of the SR 519 project is completed. The preliminary plans for the project call for a change in I-90 travel patterns, which could potentially reduce entering peak hour volumes at the Fourth Avenue S/S Royal Brougham Way intersection.

**Table 4.1-45. SODO/Chinatown International District/Pioneer Square Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010			2020		
		No Action	Alt. 5.1 ^a	Alt. 5.2/(s) ^b	No Action	Alt. 5.1 ^a	Alt. 5.2/(s) ^b
S Royal Brougham Way/First Ave S	D (51.9)	D (53.5)	D (53.6)	D (53.6)	E (57.9)	E (58.1)	E (58.1)
S Royal Brougham Way/Fourth Ave S	D (42.5)	F (128.9)	F (129.7)	F (129.7)	F (140.8)	F (141.3)	F (141.3)
S Lander St/Fourth Ave S	C (31.2)	C (29.6)	C (30.3)	C (30.3)	C (31.9)	C (32.9)	C (32.9)
S Lander St/First Ave S	D (40.0)	D (45.2)	D (45.2)	D (45.2)	E (55.1)	E (55.4)	E (55.4)
S Lander St/Utah Ave S	A (8.0)	A (8.1)	A (8.1)	A (8.1)	A (8.1)	A (8.1)	A (8.1)
S Forest St/First Ave S	A (8.2)	A (9.5)	A (9.5)	B (10.0)	A (9.5)	A (9.5)	B (10.2)
S Hanford St/First Ave S	A (6.5)	A (7.1)	A (7.1)	A (6.5)	A (7.8)	A (7.8)	A (7.2)
S Horton St/First Ave S	A (6.9)	A (7.5)	A (7.5)	A (7.5)	A (7.4)	A (7.4)	A (7.4)
S Horton St/Utah Ave S	B (11.6)	B (12.4)	B (12.4)	B (12.4)	B (12.5)	B (12.5)	B (12.5)

Source: The Transpo Group, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

^a Represents Alignment 5.1.1 and Lander 1 (Northeast) station. Results would be similar with the Lander 4 (Utah) station.

^b Represents Alignment 5.2 or 5.2(s) with Lander 3 (Diagonal) station alternative. Results would be similar with the Lander 2 (Southwest) station.

LOS estimates for the Preferred Alternative are presented in bold type.

In general, Green Line alignment and station alternatives in the SODO/Chinatown International District/Pioneer Square Segment would have minimal effect on forecast p.m. peak hour intersection operations. From No Action to Green Line conditions, intersection delay is increased by less than one second at the study intersections. Furthermore, the differences in traffic circulation and access between each station alternative result in negligible, if any, differences in intersection level of service. The most substantial change of the Green Line alternatives is in Alternative 5.1.2 on First Avenue S between S Lander and S Horton Streets. This alternative would place the columns in the west parking lane on First Avenue S, which is restricted during the p.m. peak period and is used as a third southbound travel lane.

Eliminating this third southbound lane and converting it to parking (between columns) and right-turn lanes at the signalized intersections would result in essentially the same LOS as in No Action conditions.

Table 4.1-46 summarizes a.m. peak hour level of service at key intersections under each of the alignment and station alternatives. These intersections were selected either because they are congested or because they are located in the immediate vicinity of a station and are therefore potentially subject to substantial changes. The same alternatives evaluated in the p.m. peak hour analysis were summarized in a.m. peak hour analysis, including Alternative 5.1 (East side of Third/Utah) and Alternative 5.2 (West side of Third/Utah). These alternatives include the Safeco Field station, and the Lander 1 (Northeast) station in Alternative 5.1 and the Lander 3 (Diagonal) station in Alternative 5.2. These alternatives result in the same operating conditions at the selected intersections, so the results were combined for summary purposes in Table 4.1-46.

Alternatives 5.1.1 and 5.1.2 were also evaluated. Alternative 5.1.1 was evaluated with the Lander 4 (Utah) station, located on the southwest corner of Utah Avenue S and S Lander Street. Alternative 5.1.2 was evaluated with the Lander 2 (Southwest) station option, located on the southwest corner of First Avenue S and S Lander Street.

Traffic conditions in the SODO/Chinatown International District/Pioneer Square Segment are expected to range between LOS D and LOS F in the a.m. peak hour with the Green Line. The S Royal Brougham Way/Fourth Avenue S intersection is anticipated to operate at LOS F with the No Action and Green Line Alternatives in 2010 and 2020, during the a.m. peak hour. Operations at this location may improve when Phase 2 of the SR 519 project is completed.

**Table 4.1-46. SODO Segment: a.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010				2020			
		No Action	Alt. 5.1 & 5.2	Alt. 5.1.1	Alt. 5.1.2	No Action	Alt. 5.1 & 5.2	Alt. 5.1.1	Alt. 5.1.2
S Royal Brougham Way/First Ave S	D (49.3)	D (48.7)	D (48.8)	D (48.8)	D (48.8)	D (49.6)	D (49.7)	D (49.7)	D (49.7)
S Royal Brougham Way/Fourth Ave S	E (68.5)	F (93.0)	F (94.5)	F (94.5)	F (94.5)	F (102.3)	F (103.7)	F (103.7)	F (103.7)
S Lander St/First Ave S	D (41.4)	D (47.4)	D (48.7) ^a	D (48.6) ^b	D (48.3) ^c	D (53.9)	E (55.1) ^a	E (55.1) ^b	E (54.8) ^c

Source: The Transpo Group, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

^a Represents LOS with the Lander 1 (Northeast), Lander 3 (Diagonal) station alternatives.

^b Represents LOS with the Lander 4 (Utah) station alternative.

^c Represents LOS with the Lander 2 (Southwest) station alternative.

The S Lander Street/First Avenue S intersection is expected to operate at LOS D for the 2010 No Action and Green Line Alternatives. In 2020 No Action, the intersection would operate at LOS D, just below the threshold between LOS D and LOS E. With the Green Line alternatives, intersection delay would increase by less than two seconds to result in LOS E. The westbound left-turn movement would operate at LOS F with the No Action and Green Line Alternatives; vehicular delays for this movement would increase by six seconds over No Action conditions with the Green Line in both 2010 and 2020. The remaining a.m. study intersection, S Royal Brougham Way/First Avenue S, is anticipated to operate at LOS D for 2010 and 2020 No Action and Green Line conditions.

Special Events

Traffic conditions within the study area vary greatly depending on whether games are being played at Safeco Field or Seahawks Stadium. With more weekday games than Seahawks Stadium, events at Safeco Field would have a greater impact on SODO traffic operations. The Ballpark EIS for Safeco Field estimated p.m. peak hour traffic volumes within the SODO/Chinatown International District/Pioneer Square Segment to increase as much as 90 percent (nearly double) on game days in comparison to non-game days. The effect of the Green Line on traffic operations would be cumulative with game-related impacts; however, the Green Line would be a negligible portion of the overall congestion. As noted in the operations analysis, the Green Line would increase intersection delay on the order of one percent or less, with less than two seconds increase at the SODO/Chinatown International District/Pioneer Square study intersections.

In fact, the Green Line would provide an alternative to private vehicle travel and congestion on game-days. Based on forecasts outlined in the *Seattle Monorail Project: Qualitative Estimate of Ridership for Major Events* (March 2002), an estimated five percent of baseball game attendees are expected to use the Green Line to and from Safeco Field. Five percent of event attendance equates to between 1,600 and 2,400 (based on average and maximum attendance levels) Green Line passengers on game days that would choose to use the Green Line in exchange for private vehicle trips or other modes.

Access and Circulation

Property access impacts in the SODO/Chinatown International District/Pioneer Square Segment would differ for each alternative, depending on the location of the guideway within the Third Avenue S, S Lander Street, Utah Avenue S, First Avenue S, and S Horton Street rights-of-way. Alternative 5.1 would potentially result in greater impacts to access and circulation than Alternative 5.2 or 5.2(s), since the guideway would be placed along a greater number of streets and potentially affect a greater number of loading docks. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis.

With Alternative 5.1, guideway columns would be located on the east side of Third Avenue S in the gravel parking area (from S Royal Brougham Way to S Stacy Street) or planter area (S Stacy Street to S Lander Street). Alternative 5.1 would also be located on the north side of S Lander Street, on the west side of either Utah Avenue S (Alternative 5.1.1) or First Avenue S (Alternative 5.1.2), and on the north side of S Horton Street. On S Lander Street and Utah Avenue S, the guideway columns would be placed in an existing parking or loading lane, which would not preclude left or right turning movements to and from adjacent businesses. On First Avenue S, the guideway columns would be placed in an existing parking lane with peak hour restrictions. Columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Alternative 5.2 or 5.2(s) would locate guideway columns on the west side of Third Avenue S in the gravel area (from S Royal Brougham Way to S Stacy Street) or planter area (S Stacy Street to S Lander Street). Similar to Alternative 5.1.1, guideway columns would also be placed on the west side of Utah Avenue S and on the north side of S Horton Street. As with Alternative 5.1.1, the guideway columns would be placed in an existing parking or loading lane on these streets, which would not preclude left or right turning movements to and from adjacent businesses. Columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Traffic Safety

Traffic safety impacts in the SODO/Chinatown International District/Pioneer Square Segment would primarily be caused by the introduction of guideway columns in public right-of-way. In general, columns would be placed in sidewalk, planter, or parking areas to minimize impeding vehicular or pedestrian flow, and to provide adequate sight distance around the columns. With Alternative 5.1.2, guideway columns would be placed in an off-peak parking lane and a p.m. peak southbound travel lane on First Avenue S. Traffic flow would be impeded during the p.m. peak period; however, acceptable operating conditions would be maintained. Impacts to vehicular, transit, or non-motorized safety are not anticipated. The alignment alternatives would result in increases in vehicular, transit, bicycle, and pedestrian activity in the vicinities of the station alternatives. These stations would be designed to provide safe and easy access for all modes. Alternative 5.1 would likely result in greater traffic safety impacts than Alternative 5.2 or 5.2(s), since the guideway would be placed along more roadways.

Pedestrian and Bicycle Facility Impacts

Pedestrian traffic is high near the Weller/King Street and Safeco Field stations, and is even greater before and after special events at Safeco Field and Seahawks Stadium. Pedestrian volumes decrease significantly south of Safeco Field. Sidewalks are located on most local and major arterial streets within a ¼-mile radius of the Weller/King Street station. There is a signalized mid-block crossing at the Weller Street pedestrian bridge that currently connects the Downtown Seattle Transit Tunnel International District Station to the King Street Train Station and Sound Transit's Sounder Commuter Rail Station, and in the future would provide a connection to the Green Line station. Overall, the existing pedestrian network near the Weller/King Street station alternatives would provide sufficient pedestrian access from the station location to the surrounding area.

Near the Safeco Field station, sidewalks are currently missing on Third Avenue S between S Royal Brougham Way and S Massachusetts Street and on S Atlantic Street between Third Avenue S and Fourth Avenue S. There are also missing sidewalk segments near the Lander station alternatives, most notably on Occidental Avenues S between S Stacey and S Forest Streets, on S Forest Street between First Avenue S and Occidental Avenue S, and on Utah Avenue S between S Stacey and S Forest Streets. All of the pedestrian crossings near the station alternatives have curb ramps. Table 4.1-47 summarizes the number of pedestrian trips expected at each Green Line station. No new pedestrian facilities are proposed near these stations.

Table 4.1-47. SODO/Chinatown International District/Pioneer Square Segment: Nonmotorized Facility Impact Summary

Station Name and Alternative	2020 p.m. Peak Hour Walk Trips	
	Ingress	Egress
Weller/King Street 1, and 2	108	114
Safeco Field	25	97
Lander 1, 2, 3, and 4	89	9

All sidewalks near the Green Line station alternatives currently operate at LOS A, which suggests pedestrians can walk freely along the sidewalks, with little or no conflicts with other pedestrians. All of these sidewalk locations would continue to operate at LOS B or better in the years 2010 and 2020 with both the No Action and all Green Line alignment and station alternatives. Some surges in pedestrian traffic would result from bus arrivals near the Green Line stations in the SODO Segment. Even with these surges, sidewalks near these stations would operate acceptably at LOS B or better in the years 2010 and 2020. Based on the results of the pedestrian LOS analysis, the project is not expected to affect the

sidewalk environment near the stations. During special events at Seahawks Stadium and Safeco Field, high volumes of pedestrians are typically directed by police to maintain the flow of pedestrians and traffic and to reduce the potential for conflicts between the different transportation modes. Pedestrian traffic often overflows into city streets and intersections during these surges of high pedestrian activity.

North-south bicycle routes currently exist along Alaskan Way S and E Marginal Way S, and First Avenue S and Sixth Avenue S are streets commonly used by bicyclists that would serve future Green Line passengers. Currently, there are two east-west bicycle routes near the Weller/King Street station, which are located on S Jackson Street and S Dearborn Street. South of S Dearborn Street, bicycle commuters would use arterials to travel east-west between either the Safeco Field or Lander stations and surrounding areas. Little or no bicycle parking demand is expected at these stations based on surrounding land uses, forecasted ridership, and their proximity to existing bicycle facilities. However, the SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. The SR 519/Mountains to Sound Greenway Trail is proposed to extend to the waterfront via S Royal Brougham Way, Fourth Avenue S, and S Atlantic Street.

Parking Impacts

Parking Supply

The Green Line alignment and station alternatives in the SODO/Chinatown International District/Pioneer Square Segment would result in a net loss of 153 to 337 parking spaces. These would include a combination of on-street parking losses due to layover zones at stations, on- and off-street parking losses due to column placement and switching areas, and off-street parking losses due to property takes for stations. These losses to existing parking supply are summarized by alignment alternative in Table 4.1-48. Parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS, are shown in Table 4.1-49. The parking losses shown in Table 4.1-49 for each station alternative are accounted for in the total parking losses summarized in Table 4.1-48.

Table 4.1-48. SODO/Chinatown International District/Pioneer Square Segment: Total Parking Losses – By Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement or Switching Area		Parking Losses at Station Alternatives ^b		Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street	
5.1.1 – Utah Avenue S	79	26	5 to 26	95	205 to 226
5.1.2 – First Avenue S	83	2	5 to 26	95 to 226	185 to 337
5.2 – West Side of Third/Utah	49	6	3	95	153
5.2(s) – West Side of Third/Utah single beam	54	42	3	95	194

^a Parking impacts shown are permanent displacements due to guideway column placement, bus zones, drop-and-drive areas, and property takes associated with different alignment and station alternatives.

^b See Table 4.1-49 for a detailed breakdown of these potential parking losses
Impacts for the Preferred Alternative are presented in bold type.

As shown in Table 4.1-48, Alternatives 5.1.1 (East Side of Third/Utah) and 5.1.2 (East Side of Third/First) would result in higher net parking losses than Alternative 5.2 or 5.2(s) (West Side of

Third/Utah). Alternatives 5.1.1 and 5.1.2 would displace on-street parking on Third Avenue S between S Royal Brougham Way and S Lander Street. More on-street parking spaces would be lost in the section between S Lander and S Horton Streets if the alignment is along Utah Avenue S (Alternative 5.1.1), than if the alignment is along First Avenue S (Alternative 5.1.2). Column placement on S Horton Street would displace on-street parking for both Alternatives 5.1.1 and 5.1.2. Column placement near S Lander Street for Alternatives 5.1.1, 5.1.2, 5.2, and 5.2(s), and near Utah Avenue S and S Horton Street for Alternative 5.1.1 could result in displaced off-street parking stalls. Additional off-street parking losses for Alternative 5.2(s) are the result of several switching areas along the alignment. The majority of the on-street parking stalls lost in each of the alternatives would be for short-term parking (1- to 2-hour parking) or are time restricted. Very few unrestricted stalls would be impacted by the alternatives.

The Weller/King Street station is located within the current Seahawks Stadium North Parking Lot, and as a result, would displace approximately 95 stalls for each of the proposed alternatives. The Safeco Field station would not displace any parking. The Lander station could displace between five and 145 stalls, depending on the alternative selected. The loss in parking would be due to a combination of new bus zones, bus layover space, and drop and drive areas. The Lander 2 station alternative would also displace a SODO customer parking lot, located east of Home Depot, which currently supplies 131 off-street parking spaces.

Table 4.1-49. SODO/Chinatown International District/Pioneer Square Segment: Parking Losses at Station Alternatives^a

Station	Spaces Displaced	Area Affected by Displacement
Weller/King Street 1 (Alternative 5.1)	95	Seahawks Stadium North Parking Lot (95 spaces)
Weller/King Street 2 (Alternatives 5.2 and 5.2(s))	95	Seahawks Stadium North Parking Lot (95 spaces)
Safeco Field 1 (Alternative 5.1s and 5.2(s))	0	None
Lander 1 (Alternative 5.1)	5	First Avenue (5 spaces) ^b
Lander 2 (Alternative 5.1)	145	First Avenue (8 spaces) ^b , Lander Street (6 spaces) ^b , Home Depot/SODO customer surface parking lot (131 spaces)
Lander 3 (Alternative 5.2 and 5.2(s))	3	First Avenue (3 spaces)^b
Lander 4 (Alternative 5.1)	26	Utah Avenue (26 spaces) ^b
Switching Areas (Alternative 5.2(s))^c	41	On-Street parking located at Starbucks parking lot (10 spaces), train yard east of Third Ave S/S Stacey St. (20 spaces), and northwest of I-90 off-ramp/4th Ave S (6 spaces).

^a Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. Parking losses identified for private properties do not represent losses of all available on-site parking, with the exception of the SODO customer parking lot, which would be displaced with the Lander 2 station alternative.

^b Required for bus layover, active bus stops, and/or drop-and-drive zones.

^c Parking underneath proposed switch locations has been assumed to be fully displaced. This is a conservatively high estimate of parking impacts for these areas since some parking spaces under switches could be maintained.

Impacts for the Preferred Alternative are presented in bold type.

A total of 840 on-street unrestricted parking spaces are currently provided within ¼-mile radius of the station location alternatives in the SODO/Chinatown International District/Pioneer Square Segment. The on-street unrestricted parking in the SODO Segment is currently 80 to 100 percent used during the midday hours. However, on-street parking losses shown in Tables 4.1-48 and 4.1-49 are not considered

to be significant since most of these losses occur in areas where on-street unrestricted parking is not highly used.

Parking Demand

On-street parking utilization within the vicinity of the station locations was observed to be above 70 percent in the early morning hours and between 80 and 100 percent during the mid-day hours (Refer to Appendix OO of this Final EIS, Transportation Backup Information, for a more detailed discussion of existing parking supply and demand within ¼-mile radius of each Green Line Station alternative). The limited number of available parking stalls combined with the cost of parking would reduce the potential for hide-and-ride impacts. As shown in Table 4.1-17, approximately 10 passengers at the Weller/King Station, 21 passengers at the Safeco Field Station, and 4 passengers at the Lander Station were assumed to access the Green Line via drop-and-drive during the p.m. peak hour in the year 2020. Based on existing parking utilization, it is unlikely that enough on-street unrestricted parking would be available near the Weller/King Station on a typical weekday to accommodate this potential hide-and-ride parking demand if parking management programs are not implemented.

The loss of the parking within the vicinity of the Weller/King Street and Safeco stations would be most noticeable when events are occurring in Safeco Field or in the Seahawks Stadium. On these days, parking is 100 percent used in the station areas. The boundary limits of the area that is currently used for event-day parking would slightly increase to compensate for the loss of parking due to the Green Line.

Truck Circulation Impacts

In the SODO/Chinatown International District/Pioneer Square Segment, one or more of the alignment alternatives would follow a portion of S Lander Street, which is classified as a T-3 truck route (24-320 large trucks per day); First Avenue S, which is currently classified as a T-2 truck route (320 to 800 large trucks per day); and/or S Horton Street, which is classified as a T-4 truck route (eight to 24 large trucks per day). Of these streets, First Avenue S is also classified as a major truck street in the City of Seattle Comprehensive Plan. Most trucks using these routes would travel through the SODO Segment and would not be significantly affected by the Green Line alignment alternatives. Alternative 5.1.2 has the greatest potential for truck circulation impacts based on the alignment's proximity to major truck routes and loading docks, followed by Alternative 5.1.1 and Alternative 5.2/5.2(s). A detailed discussion of each alternative follows.

Alternative 5.1 would place guideway columns on the east side of Third Avenue S and the north side of S Lander Street. From S Lander Street, the alignment would continue south along the west side of either Utah Avenue S (Alternative 5.1.1) or First Avenue S (Alternative 5.1.2), and then continue west along the north side of S Horton Street. No truck circulation impacts would be expected along these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. In particular, guideway columns should be placed to avoid truck access and circulation impacts to S Lander Street, First Avenue S, and S Horton Street, which are currently heavily used by trucks, and to avoid the high number of driveways and loading docks on the east side of Third Avenue S, the west side of Utah Avenue S (Alternative 5.1.1), and the north side of S Horton Street.

With Alternative 5.2, guideway columns would be placed on the west side of Third Avenue S. South of S Lander Street, the alignment would follow the same route as Alternative 5.1.1, with guideway columns placed on the west side of Utah Avenue S and on the north side of S Horton Street. As with Alternative 5.1.1, no truck circulation impacts would be expected along these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street

intersections, driveways, or loading docks. In particular, guideway columns should be placed to avoid the high number of driveways and loading docks on the west side of Utah Avenue S and the north side of S Horton Street. In response to comments on the Draft EIS, special long span structures have been designed in the refined Alternatives 5.2/5.2(s) to accommodate turning movements of large trucks and cranes on Utah Avenue S and S Horton Street.

Preferred Alternative

In the SODO/Chinatown International District/Pioneer Square Segment, Alternative 5.2(s) the single beam alignment, with the Weller/King Street 2, Safeco Field 1, and Lander 3 Stations is the Preferred Alternative. Guideway columns would be placed in existing parking or loading lanes on the west side of Third Avenue S, the west side of Utah Avenue S, and the north side of S Horton Street.

Table 4.1-45 summarizes the results of the p.m. peak hour level of service analysis conducted for Alternative 5.2(s). As shown in this table, most study area intersections would operate at LOS E or better in the years 2010 and 2020 with the Preferred Alternative. The only exception is the S Royal Brougham Way/Fourth Avenue S intersection, which would operate at LOS F in the years 2010 and 2020 with both the No Action and Preferred Alternatives. Table 4.1-46 summarizes the results of the a.m. peak hour LOS analysis. As shown in Table 4.1-46, the S Royal Brougham Way/Fourth Avenue S intersection would also operate at LOS F during the a.m. peak hour in the years 2010 and 2020 with both the No Action and Preferred Alternatives. Overall, the Preferred Alternative would result in similar LOS impacts as the No Action Alternative and Alternatives 5.1 and 5.2.

With regard to access and circulation, safety, and potential truck circulation impacts, placement of Green Line guideway columns on the west side of Third Avenue S, the west side of Utah Avenue S, and the north side of S Horton Street would minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to avoid impeding vehicular, pedestrian, and truck circulation at side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns. In particular, guideway columns should be placed to avoid the high number of driveways and loading docks on the west side of Utah Avenue S and the north side of S Horton Street. S Lander Street is currently classified as a T-3 truck route (24-320 large trucks per day) and S Horton Street is classified as a T-4 truck route (eight to 24 large trucks per day). The Preferred Alternative would not significantly affect these routes. Overall, the Preferred Alternative would result in fewer access and circulation, safety, and truck circulation impacts than Alternative 5.1.

Table 4.1-47 summarizes the number of pedestrian trips expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B or better in the years 2010 and 2020 with the Preferred Alternative. In addition, a number of bicycle routes are located within 1/2-mile radius of all stations associated with the Preferred Alternative. Although little or no bicycle parking demand is expected at these stations based on surrounding land uses, forecasted ridership, and their proximity to existing bicycle facilities, the SMP Board has determined to provide, at initial operations, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback.

A net loss of approximately 194 parking spaces is expected to result from the Preferred Alternative. A breakdown of parking losses is shown in Tables 4.1-48 and 4.1-49 for Alternative 5.2(s) and the different station alternatives associated with the Preferred Alternative. Approximately 19 on-street parking spaces would be displaced on the west side of Third Avenue S due to column placement. Between Third Avenue S and S Lander Street, approximately 6 off-street parking spaces from the Seattle School District parking lot would be displaced due to guideway column placement. An additional 30 on-street parking spaces would be displaced between S Lander Street and S Horton Street due to guideway column placement. On- and off-street parking spaces would also be displaced at switching areas near the I-90 off-ramp (up to

six spaces), at the train yard parking lot (up to 20 spaces), in the Starbucks parking lot (up to 10 spaces), and on S Horton Street west of Colorado Avenue S (up to five on-street spaces). In addition, the Weller/King Street 2 Station would displace approximately 95 off-street parking spaces in the Seahawks Stadium North Parking Lot, and the Lander 3 Station would displace approximately three parking spaces on First Avenue S in order to provide a drop-and-drive zone. Although the 840 on-street unrestricted parking spaces near the SODO station areas are currently approximately 80 to 100 percent utilized, the on-street parking losses associated with the Preferred Alternative are not considered to be significant since most of these losses occur in areas where on-street unrestricted parking is not highly used. The limited number of available parking stalls and relatively high utilization rates, combined with the cost of parking would reduce the potential for hide-and-ride impacts. The loss of the parking within the vicinity of the Weller/King Street 2 and Safeco Field 1 Stations would be most noticeable when events are occurring in Safeco Field or in the Seahawks Stadium. The boundary limits of the area that is currently used for event-day parking would slightly increase to compensate for the loss of parking due to the Green Line. Overall, the Preferred Alternative (Alternative 5.2(s)) would result in fewer parking losses than Alternative 5.1, but greater parking losses than Alternative 5.2.

West Seattle Segment

Alternative 6.1 was assumed to locate Green Line columns on the median of the West Seattle Bridge, the west side of Delridge Way SW, the north side of SW Andover Street, the north side of SW Yancy Street, either the northwest side (Alternative 6.1.3) or southeast side (Alternative 6.1.4) of Fauntleroy Way SW, the north side of SW Alaska Street, and the west side of 42nd Avenue SW (see Volume 3, Appendix L of the Draft EIS, Design Information). It was assumed that guideway columns would be placed in an existing parking/loading lane or sidewalk on all of these streets and all through travel lanes would be maintained. The analysis also assumed that parking could be provided between guideway columns on SW Alaska Street between 41st and 42nd Avenues SW and on Fauntleroy Way SW between 38th Avenue SW and SW Alaska Street.

Alternative 6.1 would also place guideway columns in the existing center two-way left-turn lanes on SW Avalon Way and California Avenue SW. For analysis purposes, it was assumed that full-access driveways and unsignalized intersections could be restricted to right-in, right-out access only to accommodate the guideway columns in the center of SW Avalon Way and California Avenue SW. On SW Avalon Way, the traffic analysis assumed that a new traffic signal would be provided at the SW Avalon Way/SW Genesee Street intersection, which would provide an opportunity for passenger vehicles to make left and U-turns. On California Avenue SW, the analysis assumed that left-turn movements would be retained at the SW Graham Street/California Avenue SW intersection. In addition, new traffic signals, left-turn opportunities, and pedestrian crosswalks would be provided at the following intersections along California Avenue SW: SW Brandon Street, SW Findlay Street, SW Juneau Street, and SW Raymond Street. With Alternative 6.1.6, guideway columns would be placed on the west side of California Avenue SW between SW Edmunds Street and SW Morgan Street.

The EIS also studies single beam alternatives for three areas within West Seattle – Alternative 6.1(s) over the West Seattle Bridge; Alternative 6.3(s) in the Delridge area north of the Nucor steel plant; and Alternative 6.1.6(s) along the west side of California Avenue SW.

With Alternative 6.2, guideway columns would be located on a new, monorail-only bridge near the existing West Seattle Bridge, the south side of SW Andover Street, the east side (or, alternatively, the center) of 35th Avenue SW, the center (or, alternatively, north side) of SW Alaska Street, the east side of 44th Avenue SW, and the east side of California Avenue SW. On all of these streets, the guideway columns would be placed in an existing parking/loading lane and all travel lanes would be maintained. Center alignments would be located in the center left-turn lane.

Alternative 6.2 would also place guideway columns in the existing center two-way left-turn lane along SW Avalon Way and in the center of SW Alaska Street. For analysis purposes, it was assumed that full-access driveways and unsignalized intersections could be restricted to right-in, right-out access only to accommodate the Green Line columns in the center of SW Avalon Way and SW Alaska Street. As with Alternative 6.1, the traffic analysis assumed that a new traffic signal would be provided at the SW Avalon Way/SW Genesee Street intersection, which would provide an opportunity for passenger vehicles to make left and U-turns on SW Avalon Way. No new traffic signals were assumed to be provided on SW Alaska Street; however, it was assumed that vehicles would continue to make left turns from SW Alaska Street at the following existing signalized locations: 35th Avenue SW, 39th Avenue SW/Fauntleroy Way SW, 42nd Avenue SW, and California Avenue SW.

Alternative 6.2.2 would place Green Line guideway columns on the north side of SW Alaska Street between 35th Avenue SW and Fauntleroy Way S (instead of in the center of SW Alaska Street as with Alternative 6.2), displacing some existing on-street parking. Alternative 6.2.2 would also place Green Line guideway columns in the center of 35th Avenue SW between SW Avalon Way and SW Alaska Street (instead of on the east side of 35th Avenue SW as with Alternative 6.2.1), which could restrict full-access driveways and unsignalized intersections to right-in, right-out access only.

Alternatives 6.3(s), 6.4, 6.4(s), and 6.5 are subsegment routes between SW Spokane Street and Delridge Way SW and SW Avalon Way and 35th Avenue SW. With Alternative 6.3(s), the Green Line guideway would follow the south side of the West Seattle Bridge to the center of SW Avalon Way. With this alternative, the eastbound bus-only curb lane on SW Spokane Street could be shortened in length by approximately 400 feet east of SW Avalon Way to accommodate the monorail guideway structure. In addition, a segment of the eastbound SW Spokane Street curb lane between approximately 26th Avenue SW and Chelan Avenue SW could be removed or converted to a bus-only lane. With Alternative 6.4 or 6.4(s), the Green Line would follow a route similar to Alternative 6.1, but would cross diagonally between SW Andover Street and SW Yancy Street (Alternative 6.4(s) would not have a station in the Delridge area). Alternative 6.5 would place Green Line guideway columns on the west side of Delridge Way SW and the north side of SW Genesee Street.

For all West Seattle alternatives, cross-sections assumed for the traffic analysis either meet City design standards or are consistent with existing conditions.

Traffic Volumes and Level of Service

Tables 4.1-50a and 4.1-50b summarize the 2010 and 2020 No Action and Green Line p.m. peak hour level of service analysis results for the West Seattle Segment.

In the vicinity of the Delridge station alternatives, p.m. peak hour LOS is anticipated to continue operating at LOS D or above in 2010 and 2020 with the Green Line. Alternative 6.5 (Genesee) contains the most noticeable increase in delay at the Delridge Way SW/SW Genesee Street intersection with an increase of 14 seconds in 2020 over No Action. Intersection delay for all Delridge alternatives would increase by one to 14 seconds depending on the study intersection, and all would remain at an acceptable operating level.

In the vicinity of the Avalon station alternatives, p.m. peak hour LOS is also expected to operate at LOS D or above in 2010 and 2020 with the Green Line. The Green Line could include a new traffic signal at the SW Avalon Way/SW Genesee Street intersection to facilitate left turn movements with a center alignment along SW Avalon Way. The proposed traffic signal would improve No Action LOS F operations to LOS C, for each of the station and alignment alternatives. The most noticeable effect of the Green Line alignment in the vicinity of the Avalon station would be at 35th Avenue SW/SW Avalon Way and Fauntleroy Way SW/SW Avalon Way for Alternative 6.1. The station layout would require use of the curbside westbound travel lane on SW Avalon Way between Fauntleroy Way SW and 35th Avenue SW for transit layover and drop and drive loading zones. As a result, a westbound travel lane would be displaced at both intersections. A southbound travel lane on 35th Avenue SW at Avalon Way would also

be displaced for transit layover space for Alternative 6.1. In 2010, intersection delay would increase approximately 12 to 14 seconds over No Action conditions, and the intersections would operate at LOS C. By 2020, intersection delay at 35th Avenue SW/SW Avalon Way would increase by 30 seconds over No Action conditions, and the intersection would change to LOS D. The critical movement at 35th Avenue SW/SW Avalon Way most affected by the lane removal would be the southbound-through movement. In 2010, the southbound through movement would change from LOS A with the No Action Alternative to LOS C with Alternative 6.1. In 2020, the same movement would change from LOS A to LOS F. The westbound through movement would experience approximately nine more seconds of delay in 2010 and 2020 with Alternative 6.1 as compared to No Action conditions. Delays for the westbound left-turn movement would only increase by four seconds in 2010 and 2020.

**Table 4.1-50a. West Seattle Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010			2020		
		No Action	Alt. 6.1	Alt. 6.2	No Action	Alt. 6.1	Alt. 6.2
Delridge Way SW/SW Spokane Street	D (38.0)	D (42.7)	D (42.7)	D (42.7)	D (44.5)	D (44.5)	D (44.5)
W Seattle Bridge Ramps/SW Spokane Street	A (8.8)	A (9.5)	A (9.5)	A (9.5)	B (10.4)	B (10.4)	B (10.4)
Delridge Way SW/SW Andover Street	C (20.0)	C (21.7)	C (22.4)	C (22.7)	C (22.1)	C (22.6)	C (22.8)
Delridge Way SW/SW Genesee Street	C (20.4)	C (27.5)	C (29.0)	C (31.8)	D (39.1)	D (42.2)	D (45.8)
35 th Avenue SW/Fauntleroy Way SW	C (20.5)	C (21.2)	C (20.9)	C (21.2)	C (22.7)	C (22.8)	C (22.9)
35 th Avenue SW/SW Avalon Way	B (18.2)	B (18.6)	C (30.9)	B (19.5)	B (19.1)	D (49.1)	C (20.3)
Fauntleroy Way SW/SW Avalon Way	A (6.5)	A (7.5)	C (21.0)	A (7.7)	A (8.1)	C (30.5)	A (8.3)
Fauntleroy Way SW/SW Oregon Street	A (9.7)	A (9.0)	A (8.3)	A (9.0)	B (10.2)	B (10.2)	B (10.3)
Fauntleroy Way SW/SW Alaska Street	B (19.5)	C (23.5)	C (23.9)	C (24.1)	C (24.6)	C (25.4)	C (25.6)
35 th Avenue SW/SW Alaska Street	C (20.8)	C (20.9)	C (20.1)	C (21.6)	C (22.4)	C (22.1)	C (23.2)
SW Avalon Way/SW Genesee Street	F (57.9)	F (142.0)	C (21.1) ^a	C (21.2) ^a	F (293.9)	C (22.1) ^a	C (22.2) ^a
42 nd Avenue SW/SW Alaska Street	C (21.3)	C (20.2)	C (20.8)	C (20.3)	C (21.0)	C (21.7)	C (21.3)
California Avenue SW/SW Alaska Street	D (42.8)	D (48.6)	D (48.5)	D (53.9)	E (55.6)	E (56.4)	E (63.0)
44 th Avenue SW/SW Alaska Street	B (10.2)	B (10.9)	B (10.8)	B (11.4)	B (11.8)	B (11.8)	B (12.5)
44 th Avenue SW/SW Edmunds Street	B (14.6)	C (16.2)	C (15.8)	C (16.7)	C (18.3)	C (17.7)	C (19.0)
California Avenue SW/SW Edmunds Street	D (42.8)	D (52.2)	E (55.9)	E (56.6)	E (62.2)	E (66.0)	E (66.4)
California Avenue SW/SW Brandon Street	D (32.6)	F (51.9)	A (6.6) ^a	F (57.4)	F (75.9)	A (6.8) ^a	F (86.2)
California Avenue SW/SW Graham Street	A (8.6)	A (9.2)	B (10.1)	A (9.8)	B (10.4)	B (11.9)	B (11.4)
California Avenue SW/Fauntleroy Way SW	D (41.7)	D (48.5)	E (63.9)	E (62.0)	E (62.6)	E (79.6)	E (77.7)
California Avenue SW/SW Frontenac Street	A (6.4)	A (7.9)	A (8.2)	A (8.5)	A (9.1)	A (9.4)	A (9.8)

Notes: () Average intersection delay, in seconds per vehicle.

^a Analysis assumes that new traffic signals would be provided at these locations to facilitate left and U-turn movements.

^b Also represents Alternative 6.4 and Delridge 1A..

Source: The Transpo Group, 2003.

**Table 4.1-50b. West Seattle Segment: p.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010				2020			
		No Action	Alts. 6.1.6(s) / 6.2.1 / 6.2.2	Alt. 6.3(s)	Alt. 6.5	No Action	Alts. 6.1.6(s) / 6.2.1 / 6.2.2	Alt. 6.3(s)	Alt. 6.5
Delridge Way SW/SW Spokane Street	D (38.0)	D (42.7)	- ^a	D (43.1)	D (42.7)	D (44.5)	- ^a	D (44.9)	D (44.6)
W Seattle Bridge Ramps/SW Spokane Street	A (8.8)	A (9.5)	- ^a	B (10.3)	A (9.6)	B (10.4)	- ^a	B (11.4)	B (10.5)
Delridge Way SW/SW Andover Street	C (20.0)	C (21.7)	- ^a	C (21.8)	C (22.4)	C (22.1)	- ^a	C (22.2)	C (22.6)
Delridge Way SW/SW Genesee Street	C (20.4)	C (27.5)	- ^a	C (33.1)	D (37.9)	D (39.1)	- ^a	D (46.4)	D (52.9)
SW Avalon Way/SW Spokane Street	B (13.1)	B (16.7)	- ^a	B (16.7)	B (16.7)	B (19.3)	- ^a	B (19.4)	B (19.3)
35 th Avenue SW/SW Avalon Way	B (18.2)	B (18.6)	B (19.6)	- ^a	- ^a	B (19.1)	C (20.5)	- ^a	- ^a
Fauntleroy Way SW/SW Alaska Street	B (19.5)	C (23.5)	C (24.6)	- ^a	- ^a	C (24.6)	C (26.3)	- ^a	- ^a
35 th Avenue SW/SW Alaska Street	C (20.8)	C (20.9)	C (21.7)	- ^a	- ^a	C (22.4)	C (23.4)	- ^a	- ^a
California Avenue SW/SW Brandon Street	D (32.6)	F (51.9)	F (57.3)	- ^a	- ^a	F (75.9)	F (86.0)	- ^a	- ^a
California Avenue SW/SW Graham Street	A (8.6)	A (9.2)	B (10.1)	- ^a	- ^a	B (10.4)	B (11.8)	- ^a	- ^a
California Avenue SW/Fauntleroy Way SW	D (41.7)	D (48.5)	E (63.2)	- ^a	- ^a	E (62.6)	E (78.9)	- ^a	- ^a

Notes: () Average intersection delay, in seconds per vehicle.

^a The Alternative does not include modifications that would alter LOS values from those shown in Table 4.1-50A.

Source: The Transpo Group, 2003.

Intersection delay at Fauntleroy Way SW/SW Avalon Way would increase by 22 seconds and the intersection would change to LOS C. The westbound lane removal is anticipated to cause the westbound-left critical movement at Fauntleroy Way SW/SW Avalon Way to change from LOS D with the No Action Alternative to LOS F with Alternative 6.1 for both years 2010 and 2020. Other critical movements would not be significantly affected by the Green Line. Although the level of service for critical movements would change, the intersection would remain at an acceptable operating level in 2010 and 2020 with Alternative 6.1. The alignment and station characteristics of Alternatives 6.2, 6.2.1, and 6.2.2 do not noticeably affect these two intersections. As a result, intersection level of service under Alternatives 6.2, 6.2.1, and 6.2.2 are very similar to No Action conditions.

The majority of the intersections studied in the vicinity of the Alaska and Morgan Junction stations are expected to operate at LOS E or better, in 2010 and 2020 during the p.m. peak hour with the Green Line. Intersection operations at California Avenue SW/SW Alaska Street would change to LOS E in 2020 No Action, and continue to operate at LOS E with the Green Line. Intersection delay would effectively remain the same with Alternative 6.1 and increase by approximately eight seconds with Alternative 6.2. At the California Avenue SW/SW Edmunds Street intersection, intersection operations would change from LOS D with No Action to LOS E with the Green Line in 2010. Intersection delay increases by less than four seconds, which suggests the intersection would be near LOS E conditions with the No Action Alternative. By 2020, the intersection would operate at LOS E with both No Action and the Green Line.

Green Line impacts on intersection delay would be minimal, with an increase of approximately four seconds. The northbound-through critical movement in 2010 changes from an LOS E to an LOS F, with an increase of almost 20 seconds of delay. In 2020, the northbound-through movement remains at LOS F with both No Action and the Green Line. Other critical movements are not significantly affected by the Green Line. The intersection of California Avenue SW/SW Brandon Street is currently unsignalized, and with No Action and Alternatives 6.1.6 and 6.2 conditions, is expected to operate at LOS F in 2010 and 2020. For analysis purposes, Alternative 6.1 was assumed to provide a new traffic signal at this intersection to facilitate left and U-turns on California Avenue SW with a center alignment. With a traffic signal, the intersection is expected to operate at LOS A in 2010 and 2020, and can be expected to operate similarly for Alternatives 6.1.6 and 6.2.

At the south end of the West Seattle Segment, 2010 p.m. peak hour operations at California Avenue SW/Fauntleroy Way SW would change from LOS D in No Action to LOS E with the Green Line, although that estimate does not take into account the fact that some trip-generating businesses may be displaced and that overall vehicles-miles-traveled would decrease due to the Green Line. Year 2020 p.m. peak hour operations would be LOS E in No Action and with the Green Line. Green Line alternatives' impacts would range from 13 to 17 seconds, depending on the horizon year and alignment alternative. The increase in vehicle delay is due to the vehicle trips that would be generated by the Green Line. The increase in traffic would be minor; however, it would increase traffic on sensitive turning movements that are at or near capacity, and, as a result, intersection level of service would drop one letter grade in 2010 conditions. The southbound-through critical movement is anticipated to decline from LOS D with No Action to LOS F with the Green Line in 2010 and 2020. The southbound left-turn movement operates at LOS F in No Action and remains at LOS F in 2010 and 2020. However in both 2010 and 2020, the average delay increases by approximately 20 seconds over No Action for the southbound-left-turn movement. Alternative 6.1 would not affect intersection capacity, since the alignment would travel in the center of California Way SW and left-turn lanes at the California Avenue SW/Fauntleroy Way SW intersection would be maintained.

Traffic conditions in the West Seattle Segment were evaluated in the a.m. peak hour at key study intersections where existing conditions are congested, or alignment or station alternatives could substantially change conditions. Tables 4.1-51a and 4.1-51b summarize the 2010 and 2020 a.m. peak hour LOS results for the West Seattle Segment. For Alternatives 6.3(s) and 6.5, the SW Avalon Way/SW Spokane Street intersection was also evaluated.

**Table 4.1-51a. West Seattle Segment: a.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010			2020		
		No Action	Alt. 6.1	Alt. 6.2	No Action	Alt. 6.1	Alt. 6.2
Delridge Way SW/SW Spokane Street	C (34.9)	D (36.9)	D (36.9)	D (36.9)	D (39.4)	D (39.4)	D (39.4)
Fauntleroy Way SW/SW Avalon Way	A (7.4)	A (7.9)	A (9.3)	A (8.0)	A (8.6)	B (10.3)	A (8.8)
California Ave SW/Fauntleroy Way SW	C (27.9)	C (30.1)	C (32.2)	C (31.1)	D (35.1)	D (38.6)	D (36.9)

Source: The Transpo Group, 2003.

Notes: () Average intersection delay, in seconds per vehicle.

**Table 4.1-51b. West Seattle Segment: a.m. Peak Hour Level of Service Summary
2010 and 2020 No Action and Green Line Alternatives**

Intersection	Existing	2010				2020			
		No	Alts.	Alt.	Alt. 6.5	No	Alts.	Alt.	Alt. 6.5
		Action	6.1.6(s) / 6.2.1 / 6.2.2			Action	6.1.6(s) / 6.2.1 / 6.2.2		
Delridge Way SW/SW Spokane Street	C (34.9)	D (36.9)	— ^a	D (37.1)	D (36.9)	D (39.4)	— ^a	D (39.6)	D (39.4)
SW Avalon Way/SW Spokane Street	B (15.7)	B (17.8)	— ^a	B (18.2)	B (17.8)	C (21.5)	— ^a	C (22.3)	C (21.5)
W Seattle Bridge Ramps/SW Spokane Street	A (9.9)	B (11.0)	B (11.0)	B (18.2)	B (11.0)	B (11.6)	B (11.6)	C (32.4)	B (11.6)
California Avenue SW/Fauntleroy Way SW	C (27.9)	C (30.1)	C (32.0)	— ^a	— ^a	D (35.1)	D (38.2)	— ^a	— ^a

Notes: () Average intersection delay, in seconds per vehicle.

^a The Alternative does not include modifications that would alter LOS values from those shown in Table 4.1-51A.

Source: The Transpo Group, 2003.

The Delridge Way SW/SW Spokane Street intersection in the vicinity of the Delridge station is anticipated to operate at LOS D with 2010 and 2020 No Action and with the Green Line. Fauntleroy Way SW/SW Avalon Way is anticipated to operate at LOS A in 2010 and 2020 No Action conditions. With Alternative 6.1, year 2010 intersection operations would remain at LOS A and year 2020 operations would change to LOS B. The Avalon station would displace a westbound travel lane, which would cause the intersection level of service to decline. With Alternative 6.2, the intersection would remain at LOS A during the a.m. peak hours in 2010 and 2020. The California Avenue SW/Fauntleroy Way SW intersection is expected to operate at LOS C with year 2010 No Action and with the Green Line and LOS D with year 2020 No Action and with the Green Line. The alignment and station alternatives would minimally affect intersection delay, with a one to four second increase over No Action conditions.

With Alternative 6.3(s), the eastbound bus-only curb lane on SW Spokane Street could be shortened in length by approximately 400 feet east of SW Avalon Way to accommodate the monorail guideway structure. With this change, any buses merging into the transit-only lane from either of the two general-purpose lanes would be required to merge slightly further to the east than where they currently enter this lane. Based on preliminary bus routing plans, up to 20 Metro buses that currently using this lane to access the West Seattle Bridge would be rerouted to serve the Delridge 3 Station, and thus would no longer use this transit-only lane. However, the occasional tour buses, school buses, or other buses currently using this transit-only lane to access the West Seattle Bridge during the a.m. peak hour could experience delays of up to 60 seconds when vehicle queues form in the general-purpose lane. No impacts to general-purpose traffic are expected to result from the shortening of the eastbound transit-only lane, since this traffic revision would likely decrease the number of weaving movements made by buses along SW Spokane Street.

Alternative 6.3(s) could also require the removal of a segment of the eastbound SW Spokane Street curb lane between approximately 26th Avenue SW and Chelan Avenue SW to accommodate a bus layover/stop area near the Delridge 3 station. This would result in the loss of one eastbound general-purpose lane at the West Seattle Bridge Ramps/SW Spokane Street intersection. As shown in Table 4.1-51b, the West Seattle Bridge Ramps/SW Spokane Street intersection would operate at LOS B during the a.m. peak hour in the years 2010 and 2020 with the No Action and most Green Line Alternatives. With Alternative 6.3(s) this intersection would degrade to LOS C and average vehicle delays would increase by approximately 7.2 seconds in the year 2010 and by approximately 20.8 seconds in the year 2020 due to

the removal of one eastbound general-purpose lane. Existing eastbound queues extending back from the Delridge Avenue SW/SW Spokane Street intersection during the a.m. peak hour would likely continue and could worsen with the removal of the eastbound general-purpose lane.

Access and Circulation

Property access impacts in the West Seattle Segment would differ for each alignment alternative, depending on the location of the guideway within roadway rights-of-way. Overall, Alternative 6.1 would have a greater potential for access and circulation impacts than Alternative 6.2, due to the placement of guideway columns in the center of California Avenue SW. The potential for access and circulation impacts is reduced with Alternative 6.1.6 or 6.1.6(s), which would place monorail guideway columns on the west side of California Avenue SW. Refer to Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS for a description of the roadway cross sections and traffic revisions (including lane widths, sidewalk/planter configurations, and guideway column locations) assumed for this analysis.

Alternative 6.1 would locate guideway columns in the median of the West Seattle Bridge, the west side of Delridge Way SW, the north side of SW Andover Street, the north side of SW Yancy Street, either the northwest side (Alternative 6.1.3) or southeast side (Alternative 6.1.4) of Fauntleroy Way SW, the north side of SW Alaska Street, and the west side of 42nd Avenue SW. On all of these streets, the guideway columns would be placed in an existing parking/loading lane or sidewalk area, which would minimize impacts to left or right turning movements to and from adjacent businesses. Columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Alternative 6.1 would also place guideway columns in the existing center two-way left-turn lanes on SW Avalon Way and California Avenue SW. Property access impacts are expected in the form of reduced left-turn opportunities. Existing full-access driveways and unsignalized intersections would likely be restricted to right-in, right-out access only to accommodate the guideway columns in the center of SW Avalon Way and California Avenue SW. The vehicular access restrictions caused by placement of guideway columns in the center two-way left-turn lane is not expected to significantly affect p.m. peak hour conditions, although the left-turn prohibitions could result in some out-of-direction travel for motorists to reach their destinations. The analysis assumed that new signalized intersections with left turn channelization and pedestrian crosswalks could be provided at several locations on SW Avalon Way and California Avenue SW, which would reduce the potential for these impacts.

With Alternative 6.1.6 or 6.1.6(s), guideway columns would be placed on the west side of California Avenue SW between SW Edmunds Street and SW Morgan Street, which would further reduce the potential for access and circulation impacts on California Avenue SW.

With Alternative 6.2, guideway columns would be located on a new monorail-only bridge, the south side of SW Andover Street, the east side (or center) of 35th Avenue SW, the east side of 44th Avenue SW, and the east side of California Avenue SW. On all of these streets, the guideway columns would be placed in an existing parking/loading lane, which would minimize impacts to left or right turning movements to and from adjacent businesses. Columns would be located to minimize impeding side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Alternative 6.2 would also place guideway columns in the existing center two-way left-turn lane of SW Avalon Way, and in the center of SW Alaska Street. Property access impacts on these streets are expected in the form of reduced left-turn opportunities. Existing full-access driveways and unsignalized intersections would likely be restricted to right-in, right-out access only to accommodate the columns in the center of SW Avalon Way and SW Alaska Street. The vehicular access restrictions caused by the

continuous median is not expected to significantly affect p.m. peak hour conditions, although the left-turn prohibitions could result in some out-of-direction travel for motorists to reach their destinations. The analysis assumed that a new signalized intersection with left turn channelization and pedestrian crosswalks could be provided at the SW Genesee Street/SW Avalon Way intersection, which would reduce the potential for these impacts.

Alternative 6.2.2, which would place Green Line guideway columns on the north side instead of the center of SW Alaska Street between 35th Avenue SW and Fauntleroy Way SW, could reduce the potential for access and circulation impacts associated with Alternative 6.2.1. Alternative 6.2.2 would also place Green Line guideway columns in the center of 35th Avenue SW between SW Avalon Street and SW Alaska Street instead of on the east side of 35th Avenue SW, which could result in a slight increase in access and circulation impacts associated with Alternative 6.2 due to the restriction of full-access driveways and unsignalized intersections to right-in, right-out access only.

None of the subsegment routes between SW Delridge Way and SW Avalon Way (Alternatives 6.3(s), 6.4, 6.4(s), and 6.5) would substantially differ from Alternatives 6.1 and 6.2 with regard to access and circulation impacts, since all of these alignments would place Green Line guideway columns in existing parking or planter areas, and would retain all existing travel lanes on affected roadways.

Traffic Safety

Traffic safety impacts in the West Seattle Segment would primarily be caused by the introduction of guideway columns in the public right-of-way. Alternative 6.1 would likely result in greater traffic safety impacts than Alternative 6.2, due to the placement of guideway columns in the center turn lane of California Avenue SW. This potential is reduced with Alternatives 6.1.6 and 6.1.6(s), which would place Green Line guideway columns on the west side of California Avenue SW.

In most areas, columns would be placed in sidewalk, planter, or parking areas to minimize impeding vehicular or pedestrian flow, and to provide adequate sight distance around the columns.

The introduction of guideway columns in the center of SW Avalon Way and California Avenue SW with Alternative 6.1, in the center of SW Avalon Way and SW Alaska Street with Alternative 6.2, and in the center of 35th Avenue SW with Alternative 6.2.2 could result in a reduction in midblock accidents due to the elimination of left-turn movements at unsignalized intersections and driveways. Prohibiting these mid-block left turns would virtually eliminate the potential for midblock left-turn and right-angle vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents. On the other hand, left-turn restrictions at unsignalized driveways and intersections could lead to increased traffic due to out-of-direction travel on parallel arterial or local access streets.

The Green Line would result in increases in vehicular, transit, bicycle, and pedestrian activity in the vicinity of the stations. These stations would be designed to provide safe and convenient access for all travel modes.

Pedestrian and Bicycle Facility Impacts

Pedestrian volumes vary through West Seattle. Pedestrian volumes tend to be higher near the locations for the Avalon and Alaska Junction station alternatives, compared to the Delridge and Morgan Junction station alternatives. The higher volumes near the Avalon and Alaska Junction stations can be attributed to the high density and mixed land uses and major bus stops at those locations. In addition, pedestrian volumes are high at the SW Morgan Street/California Avenue SW intersection, which are also due to the mixed land use development near this intersection.

There are continuous sidewalks on all major arterial streets leading to the four station alternatives. The existing sidewalks would provide residents, students, and employees working in the area adequate and safe walking routes to access the station alternatives. There are crosswalks at all the signalized intersections within the area. Most curbs and sidewalks within the immediate vicinity of the station alternatives have curb ramps. However, at the Avalon station curb ramps are only provided on the north side of Fauntleroy Way SW at the Fauntleroy Way SW/SW Oregon Street intersection. There are no curb ramps at the Fauntleroy Way SW/38th Avenue SW intersection. Table 4.1-52 summarizes the number of pedestrian trips expected at each Green Line station. No pedestrian facilities are proposed near these stations.

Table 4.1-52. West Seattle Segment: Nonmotorized Facility Impact Summary

Station Name and Alternative	2020 P.M. Peak Hour Walk Trips	
	Ingress	Egress
Delridge 1, 1A, 2, 3, and 4	9	22
Avalon 1, 2, 2A, and 2B	11	28
Alaska Junction 1, 1A, and 2	31	43
Morgan Junction 1, 1A, and 2	26	110

All sidewalks evaluated near the station locations currently operate at LOS A and would continue to do so in the year 2010 with No Action and all Green Line Alternatives. In the year 2020, the pedestrian LOS would decline to LOS B at a few intersections with the Green Line; however, the change would have an insignificant effect on pedestrian travel. At LOS B, sufficient sidewalk area is available for pedestrians to select walking speeds to bypass other pedestrians, and to avoid crossing conflicts with other pedestrians. Some surges in pedestrian traffic would result from bus arrivals near the Green Line stations in the West Seattle Segment. Even with these surges, sidewalks near these stations would operate acceptably at LOS B or better in the years 2010 and 2020.

With Alternative 6.3(s), placement of Green Line guideway columns on SW Spokane Street would remove the existing sidewalk on the south side of the street. This sidewalk does not connect to other pedestrian facilities in the area and therefore has limited function.

There are bicycle connections to all of the West Seattle station alternatives and to the surrounding neighborhoods south and east of West Seattle. These include designated bicycle routes and streets commonly used by bicycles that would provide Green Line passengers an alternative to using transit, or walking to their origin or destination from the stations.

Table 4.1-53 summarizes the bicycle storage facilities proposed at each station based on projected bicycle demand. Bicycle demand was categorized as low (250 square feet), medium (500 square feet), or high (1,000 square feet) based on surrounding land uses, ridership forecasts, and adjacent bicycle facilities. The SMP Board has determined to provide, at initial operations, 30 bicycle spaces at each terminus station, 20 bicycle spaces at each neighborhood station, and 10 spaces at each station within the Downtown Turnback. The higher figures represented in the table represent a longer-term space allocation, demonstrating how space could be provided for higher numbers of bicycles if demand increases.

Table 4.1-53. West Seattle Segment: Proposed Bicycle Facilities

Station Name	Proposed Bicycle Parking Area ^a	Bicycle Storage Facilities ^b (Number of Bicycles)
Delridge 1, 1A, 2, 3, and 4	1,000 square feet	48
Avalon 1, 2, 2A, and 2B	1,000 square feet	48
Alaska Junction 1, 1A, and 2	1,000 square feet	48
Morgan Junction 1, 1A, and 2	750 square feet	30

^a Space allocation includes areas for future expansion

^b The number of bicycles accommodated assumes covered racks. The amount of parking provided at project opening may be less than shown.

Parking Impacts

Parking Supply

The Green Line alignment and station alternatives in the West Seattle Segment would result in a net loss of 171 to 602 parking spaces between S. Horton Street and Morgan Junction Station. These include a combination of on-street parking losses due to layover zones at stations, on- and off-street parking losses due to column placement and switching areas, and off-street parking losses due to property takes for station facilities. These losses to existing parking supply are summarized by subsegment alternative in Table 4.1-54. Table 4.1-55 summarizes the parking losses associated with each station alternative, based on the conceptual station footprint plans in Volume 2, Appendix L of the Draft EIS and Appendix LL of this Final EIS. The parking losses shown in Table 4.1-55 for each station alternative are accounted for in the total parking losses summarized in Table 4.1-54. Metro and SMP staff have discussed the possibility that Metro might reconfigure bus stops on California Avenue SW, potentially freeing up a number of on-street parking spaces between columns.

As shown in Table 4.1-54, in the Delridge subsegment, Alternative 6.1 would displace parking stalls on the west side of Delridge Way SW, but additional stalls would be gained on the east side of Delridge Way SW. Column placement would also displace a small amount of on-street parking on SW Yancy Street and on 42nd Avenue SW. To provide left-turn and U-turn channelization at SW Avalon Way at SW Genesee Street, up to 21 on-street parking spaces would be lost along SW Avalon Way. Alternatives 6.2, 6.3(s), 6.4, 6.4(s) and 6.5 also could displace between 10 and 25 on-street parking spaces along SW Avalon Way to provide left-turn and U-turn channelization at signalized intersections. Alternative 6.3(s) includes displacements along SW Avalon Way at SW Spokane Street, whereas Alternative 6.5 only includes displacements on the south side of the SW Avalon Way/SW Genesee Street intersection due to the alignment turning down SW Genesee Street. Alternative 6.5 removes an additional 65 on-street parking spaces along SW Genesee Street due to column placement. Off-street parking displaced by columns in Alternatives 6.1 includes 34 parking stalls on Terminal 25 property west of East Marginal Way. Alternatives 6.3(s), 6.4, and 6.5 are anticipated to follow the Alternative 6.1 alignment from SODO to the West Seattle Bridge and also reflect that loss. A switching area also located on Terminal 25 property would displace an additional eight parking spaces with the single beam option. Alignment 6.1 includes an additional 10 off-street parking spaces on Seattle Commerce Center property. Column placements for Alternative 6.4 displace an additional 34 parking stalls on Seattle Commerce Center and Nucor Steel properties. Alternative 6.4(s), the no station alternative, follows the 6.4 alignment, but would displace six parking stalls in the SGA Building lot due to column placement.

Table 4.1-54. West Seattle Segment: Total Parking Losses – By Alignment Alternative^a

Alternative	Parking Losses Due to Column Placement or Switching Area		Parking Losses at Station Alternatives ^c		Potential New All-Day On-Street Parking Spaces ^b	Net Parking Loss
	On-Street	Off-Street	On-Street	Off-Street		
Duwamish Crossing Subsegment						
6.1 – West Seattle I	0	34	0	0	0	34
6.1 (s) – West Seattle I (Single Beam)	0	42	0	0	0	42
6.2 – West Seattle II	24	0	0	0	0	24
Delridge Subsegment						
6.1 – West Seattle I ^d	31 to 56	10	26	136	27	176 to 201
6.2 – West Seattle II ^d	14 to 35	0	23	83	0	120 to 141
6.3 (s) – Delridge North (Single Beam) ^d	0 to 25	0	0	0	0	0 to 25
6.4 – Andover/Yancy ^d	45 to 66	34	15	136	0	230 to 251
6.4 (s) – Andover/Yancy (Single Beam – No Station) ^d	45 to 66	40	0	0	0	85 to 106
6.5 – Genesee ^d	88 to 98	0	3	20	27	84 to 94
Avalon Subsegment						
6.1 – West Seattle I	8	0	0	0	5	3
6.1.3 – Northwest Side of Fauntleroy Way SW	8	0	0	0	5	3
6.1.4 – Southeast Side of Fauntleroy Way SW	8	0	0	0	5	3
6.2 – West Seattle II	22	0	23	0	0	45
6.2.1 – East on 35 th , North Side of Alaska	33	0	23	0	0	56
6.2.2 – Center of 35 th North Side of Alaska	33	0	23	0	0	56
Alaska Subsegment						
6.1 – West Seattle I	16	0	23	42	5	76
6.2 – West Seattle II	10	0	15	60	0	85
California/Morgan Junction Subsegment						
6.1 – West Seattle I ^e	0 to 160	0	8	0	0	8 to 168
6.1.6 – West of California	60	0	8	0	0	68
6.1.6 (s) – West of California (Single Beam)	69	0	8	0	0	77
6.2 – West Seattle II	40	0	8	41	0	89

^a Parking impacts shown are permanent displacements due to guideway column placement, bus zones, drop-and-drive areas, and property takes associated with different alignment and station alternatives.

^b New on-street parking spaces could be added between guideway columns in some locations where parking does not currently exist.

^c See Table 4.1-55 for a detailed breakdown of these potential parking losses.

^d The low range of parking losses shown assumes that no left or U-turns would be provided at signalized or unsignalized intersections along SW Avalon Way in the existing center two-way turn lane. The high range reflects the additional parking losses that could result if left and U-turn channelization is provided on SW Avalon Way at SW Genesee Street. Alignment Alternative 6.3(s) reflects additional losses for left and U-turn channelization on SW Avalon Way at SW Spokane Street. Alignment Alternative 6.5 reflects parking losses for left and U-turn channelization on only the southern approach of the SW Avalon Way at SW Spokane Street intersection.

^e The low range of parking losses shown for alignment Alternative 6.1 assumes that no left or U-turns would be provided at signalized or unsignalized intersections along California Avenue SW due to column placement in the existing center two-way left-turn lane. The high range reflects the additional parking losses that could result if left/U-turn channelization is provided at the following signalized intersections on California Avenue SW: SW Brandon Street, SW Findlay Street, SW Juneau Street, SW Raymond Street, and SW Graham Street.

In the California/Morgan Junction subsegment, Alternative 6.1 (Center of California) could result in higher net parking losses than Alternatives 6.1.6/6.1.6(s) (West Side of California) and 6.2 (East Side of California). With Alternative 6.1, column placement would displace 16 on-street parking spaces on California Avenue SW between Fauntleroy Way SW and SW Edmunds Street. Alternative 6.1 could also displace up to an additional 160 parking spaces along California Avenue SW if left-turn and U-turn

channelization is provided at signalized intersections along the corridor. However, 16 new parking spaces could be provided between columns on SW Alaska Street between 41st and 42nd Avenues SW, and on Fauntleroy Way SW between 38th Avenue SW and SW Alaska Street.

Alternative 6.1.6/6.1.6(s) results in an on-street parking loss of approximately 76 parking spaces due to column placement along the west side of California Avenue SW and 42nd Avenue SW, and an additional 9 parking spaces under designated switching locations with the single-beam guideway option between Morgan Junction and Avalon. Approximately 72 on-street parking stalls are displaced with Alternative 6.2 along California Ave SW, 35th Avenue SW, and 44th Avenue SW due to column placement, with an additional 11 spaces displaced along SW Alaska Street for Alternative 6.2.2 due to parking being eliminated on the north side of the street. No off-street parking for any of the alternatives is impacted by column placement between the Morgan Junction and Avalon Stations.

On-street parking spaces displaced in the Delridge station alternatives vary between 0 and 26 spaces. The Delridge 3 (north of Nucor) station associated with Alternatives 6.3(s) removes no on-street parking, whereas Alternatives 6.1 and 6.4 remove between 15 to 26 spaces displaced as a result of new bus zones and drop and drive locations. Delridge 1A (26th) removes 15 spaces as opposed to 26 spaces by Delridge 1 (26th) because of fewer bus zones and drop and drive locations. Alternative 6.2 and Delridge 2 (Andover) remove approximately 23 parking spaces on SW Andover Street and 26th Avenue SW. Only three on-street parking spaces are removed for Alternative 6.5 (Genesee). All of the displaced stalls at the Delridge stations are unrestricted stalls. Alternatives 6.1, 6.2, and 6.4 would displace 83 off-street parking stalls at the SGA Building parking lot north of SW Yancy Street. An additional 53 off-street spaces on SGA Building property would be removed in Alternatives 6.1 and 6.4 south of SW Yancy Street for a new bus layover area. Alternative 6.3(s) (north of Nucor) would have no off-street parking impacts, whereas Alternative 6.5 (Genesee) would remove 20 parking stalls at the DSHS Building.

The station alternatives being evaluated for Alternative 6.1 would displace 50 percent fewer on-street parking spaces compared to the station alternatives for Alternative 6.2 between the Avalon and Morgan Junction Stations. Between 31 and 46 on-street parking stalls could be displaced as a result of new bus zones and layover space and drop and drive locations. The displaced stalls at the Avalon and Morgan Junction stations are unrestricted stalls, whereas the displaced stalls at the Alaska Junction station alternatives are short-term parking stalls. Alternative 6.1 would also displace the Petco parking lot (42 off-street parking spaces) with the Alaska Junction 1 station alternative. Alternative 6.2 would displace a total of 161 off-street parking spaces through partial property takes at the Morgan Junction 2 station, and full takes of a portion of the West Seattle Junction parking lot (60 parking spaces) at the Alaska Junction 2 station.

The parking losses shown in Tables 4.1-54 and 4.1-55 would not result in significant impacts to existing parking supply, since a total of 5,824 existing on-street unrestricted parking spaces are currently provided within ¼-mile radius of the station locations. Depending on the final alignment, the total loss in on-street parking represents less than five percent of this total parking supply. Furthermore, on-street unrestricted parking near the station locations is currently 26 to 43 percent used during the midday.

Table 4.1-55. West Seattle Segment: Parking Losses at Station Alternatives and Switching Areas^a

Station	Spaces Displaced	Area Affected by Displacement
Delridge 1 (Alternative 6.1)	162	SW Andover Street (6 spaces) ^b , 26 th Avenue SW (20 spaces) ^b , SGA Building (136 spaces) ^c
Delridge 1A (Alternative 6.4)	151	SW Andover Street (6 spaces) ^b , 26 th Avenue SW (9 spaces) ^b , SGA Building (136 spaces) ^c
Delridge 2 (Alternative 6.2)	106	SW Andover Street (6 spaces) ^b , 26 th Avenue SW (17 spaces) ^b , SGA Building (83 spaces)
Delridge 3 (Alternative 6.3(s))	0	None
Delridge 4 (Alternative 6.5)	23	Delridge Way SW (3 spaces) ^b , DSHS Building (20 spaces)
Avalon 1 (Alternative 6.1)	0	None
Avalon 2A (Alternative 6.2)	23	35 th Avenue SW (23 spaces) ^b
Avalon 2B (Alternative 6.2)	23	35 th Avenue SW (23 spaces) ^b
Alaska Junction 1 (Alternative 6.1)	65	42nd Avenue SW (23 spaces) ^b , Petco Parking Lot (42 spaces)
Alaska Junction 1A (Alternative 6.1)	65	42nd Avenue SW (23 spaces) ^b , Petco Parking Lot (42 spaces)
Alaska Junction 2 (Alternative 6.2)	75	44th Avenue SW (15 spaces) ^b , West Seattle Junction Parking (60 spaces)
Morgan Junction 1 (Alternative 6.1)	8	California Avenue SW (5 spaces) ^b , NW Eddy Street (3 spaces) ^b
Morgan Junction 1A (Alternative 6.1)	8	California Avenue SW (5 spaces) ^b , NW Eddy Street (3 spaces) ^b
Morgan Junction 2 (Alternative 6.2)	49	California Avenue SW (8 spaces) ^b , Thriftway (36 spaces), Marnae Apartments (5 spaces)
Alternative 6.1(s) and Alternative 6.1.6 (s) Switching Areas ^d	17	California Avenue SW (9 spaces), Terminal 25 (8 spaces)
Alternative 6.3(s) Switching Areas	0	None

^a Parking impacts shown are permanent displacements; parking losses associated with construction staging are not included in this summary. In general, parking losses identified for private properties do not represent losses of all available on-site parking. Exceptions include the Petco Parking lot, which would be displaced with the Alaska Junction 1 station alternative, and a portion of the West Seattle Junction parking lot, associated with the Alaska Junction 2 station alternative.

^b Required for bus layover, active bus stops, and/or drop-and-drive zones.

^c Off-street parking losses include additional parking lot south of SW Yancy Street required for bus layover.

^d Parking underneath proposed switch locations has been assumed to be fully displaced. This is a conservatively high estimate of parking impacts for these areas since some parking spaces under switches could be maintained.

Parking Demand

Parking demand within the West Seattle Segment was observed to occupy less than 50 percent, on average, of the available on-street parking supply in the early morning and mid-day hours (Refer to Appendix OO of this Final EIS, Transportation Backup Information, for a more detailed discussion of existing parking supply and demand within a ¼-mile radius of each Green Line station alternative). The on-street parking that is currently available would exceed the amount of parking displaced through station and alignment impacts. Impacts would be localized to parcels that would lose on-street parking immediately adjacent to their business or home. However, the analysis indicates that on-street parking options would be available within walking distance of the stations, which could result in some hide-and-ride parking impacts. As shown in Table 4.1-17, approximately 23 passengers at the Delridge Station, 14 passengers at the Avalon Station, 16 passengers at the Alaska Junction Station, and 36 passengers at the Morgan Junction Station were assumed to access the Green Line via drop-and-drive during the p.m. peak hour in the year 2020. If on-street unrestricted parking continues to be available near these stations, some of these auto trips may choose to hide-and-ride near the stations. This potential hide-and-ride parking demand could be accommodated by on-street unrestricted parking within 1/4-mile radius of Green Line stations if parking management programs are not implemented. In addition, approximately 110 existing off-street park-and-ride spaces along SW Spokane Street near the Delridge 3 station could be used by Green Line passengers. Based on midday parking utilization counts, approximately 60 percent of this available parking supply is currently used by Metro bus passengers. Mitigation measures to address potential hide-and-ride impacts are discussed in Chapter 5.

Truck Circulation Impacts

In the West Seattle Segment, alternative 6.1 is located on the West Seattle Bridge, which is classified as a T-1 truck route (over 800 large trucks per day) and on Fauntleroy Way SW, which is classified as a T-2 truck route (320 to 800 large trucks per day). Alternative 6.1 would have a greater potential for truck circulation impacts than Alternative 6.2, due to the addition of guideway columns in the center of California Avenue SW and the alignment's proximity to major truck routes. The potential for truck impacts is reduced with Alternative 6.1.6, which places Green Line guideway columns on the west side of California Avenue SW rather than in the center. A detailed discussion of each alternative follows.

With Alternative 6.1, guideway columns would be placed on the median of the West Seattle Bridge, the west side of Delridge Way SW, the north side of SW Andover Street, the north side of SW Yancy Street, either the northwest side (Alternative 6.1.3) or southeast side (Alternative 6.1.4) of Fauntleroy Way SW, the north side of SW Alaska Street, and the west side of 42nd Avenue SW. No truck circulation impacts would be expected along these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks. Placement of guideway columns in a center median on the West Seattle Bridge would not result in any truck circulation impacts.

Alternative 6.1 would also place guideway columns in the existing two-way left turn lane in the center of SW Avalon Way and California Avenue SW. Existing full-access driveways and unsignalized intersections could be limited to right-in, right-out access only. Left turns could be restricted to signalized intersections and U-turns could be permitted for passenger vehicles only at most signalized intersections to minimize the impact of these turn prohibitions. Travel time increases and delays for trucks are anticipated as a result of the left-turn restrictions, since some trucks would be diverted to other arterial roadways to reach their destinations.

With Alternative 6.1.6 or 6.1.6(s), guideway columns would be placed on the west side of California Avenue SW between SW Edmunds Street and SW Morgan Street, which would reduce the potential for truck circulation impacts on California Avenue SW as compared with a center of street alignment.

With Alternative 6.2, guideway columns would be located on a new monorail-only bridge, the south side of SW Andover Street, the east side of 35th Avenue SW, the east side of 44th Avenue SW, and the east side of California Avenue SW. No truck circulation impacts would be expected along these roadways if columns are placed to provide adequate sight distance and allow full turning movements without impeding side street intersections, driveways, or loading docks.

Alternative 6.2 would also place guideway columns in the existing center two-way turn left lane of SW Avalon Way and in the center of SW Alaska Street. Existing full-access driveways and unsignalized intersections could be limited to right-in, right-out access only. Left turns could be restricted to signalized intersections and U-turns could be permitted for passenger vehicles only at most signalized intersections to minimize the impact of these turn prohibitions. Travel time increases and delays for trucks are anticipated as a result of the left-turn restrictions, since some trucks would be diverted to other arterial roadways to reach their destinations.

Alternative 6.2.2, which would place Green Line guideway columns on the north side instead of the center of SW Alaska Street between 35th Avenue SW and Fauntleroy Way SW, could reduce the potential for truck circulation impacts associated with Alternative 6.2. Alternative 6.2.2 would also place Green Line guideway columns in the center of 35th Avenue SW between SW Avalon Way and SW Alaska Street instead of on the east side of 35th Avenue SW, which could result in a slight increase in

truck circulation impacts associated with Alternative 6.2 due to the restriction of full-access driveways and unsignalized intersections to right-in, right-out access only.

None of the subsegment routes between SW Delridge Way and SW Avalon Way (Alternatives 6.3(s), 6.4/6.4(s), and 6.5) would substantially differ from Alternatives 6.1 and 6.2 with regard to truck circulation impacts, since all of these alignments would place Green Line guideway columns in existing parking or planter areas, and would retain all existing travel lanes on affected roadways.

Preferred Alternative

In the West Seattle Segment, different subsegments from Alternative 6.1(s), 6.3(s), 6.2.2, 6.1, and 6.1.6(s) have been combined with the Delridge 3, Avalon 2B, Alaska Junction 1, and Morgan Junction 1A Station Alternatives to form the Preferred Alternative. The result is an alignment that places guideway columns in the median of the West Seattle Bridge, the south side of SW Spokane Street, the center of SW Avalon Way, the center of 35th Avenue SW, the north side of SW Alaska Street, the west side of 42nd Avenue SW, and the west side of California Avenue SW. Guideway columns would be placed in an existing parking/loading lane or sidewalk along most of these streets and all through travel lanes would be maintained. Exceptions include SW Spokane Street, SW Avalon Way and 35th Avenue SW. On SW Spokane Street, placement of the guideway on the south side of the street would shorten the existing transit-only lane by approximately 400 feet east of SW Avalon Way, and the eastbound curb lane between approximately 26th Avenue SW and Chelan Avenue SW could be removed or converted to a bus-only lane. The guideway would be placed in the center of SW Avalon Way and 35th Avenue SW.

Tables 4.1-50a and 4.1-50b summarize the results of the p.m. peak hour level of service (LOS) analysis conducted for the different alternatives forming the Preferred Alternative. As shown in these tables, most study area intersections would operate at LOS E or better in the years 2010 and 2020 with the Preferred Alternative. The only exception is the unsignalized California Avenue SW/SW Brandon Street intersection, which would operate at LOS F in the years 2010 and 2020 with the No Action and Preferred Alternative. Tables 4.1-51a and 4.1-51b summarize the results of the a.m. peak hour LOS analysis. As shown in these tables, all intersections evaluated would operate at LOS D or better during the a.m. peak hour in the years 2010 and 2020 with the Preferred Alternative. In general, LOS impacts with the Preferred Alternative would not significantly differ from the No Action and other Green Line alternatives. Exceptions include: West Seattle Bridge Ramps/SW Spokane Street intersection – which would degrade from LOS B with No Action and other Green Line Alternatives to LOS C with the Preferred Alternative in the year 2020 due to the removal of an eastbound general-purpose lane On SW Spokane Street; Fauntleroy Way SW/SW Avalon Way intersection - which would operate worse with Alternative 6.1; the California Avenue SW/SW Alaska Street intersection – which would operate worse with Alternative 6.2; and the California Avenue SW/SW Brandon Street intersection - which would operate better with Alternative 6.1 due to the assumption that this intersection would be signalized.

With the Preferred Alternative, the eastbound bus-only curb lane on SW Spokane Street could be shortened in length by approximately 400 feet east of SW Avalon Way to accommodate the monorail guideway structure. With this change, any buses merging into the transit-only lane from either of the two general-purpose lanes would be required to merge slightly further to the east than where they currently enter this lane. Based on preliminary bus routing plans, up to 20 Metro buses currently using this lane to access the West Seattle Bridge would be rerouted to serve the Delridge 3 Station, and thus would no longer use this transit-only lane. However, the occasional tour buses, school buses, or other buses currently using this transit-only lane to access the West Seattle Bridge during the a.m. peak hour could experience delays of up to 60 seconds when vehicle queues form in the general-purpose lane. No impacts to general-purpose traffic are expected to result from the shortening of the eastbound transit-only lane, since this traffic revision would likely decrease the number of weaving movements made by buses along SW Spokane Street.

With regard to access and circulation, safety, and potential truck circulation impacts, placement of Green Line guideway columns in the center of the West Seattle Bridge, the south side of SW Spokane Street, the north side of SW Alaska Street, the west side of 42nd Avenue SW, and the west side of California Avenue SW would minimize impacts to left or right turning movements to and from adjacent businesses. Columns could be located to avoid impeding vehicular, pedestrian, and truck circulation at side street intersections, driveways, or loading docks, and to provide adequate sight distance around the columns.

Placement of the guideway columns in the center median of SW Avalon Way and 35th Avenue SW, however, would result in some vehicular property access. These impacts are expected in the form of reduced left-turn opportunities. Existing full access driveways and unsignalized intersections would be restricted to right-in, right-out access only to accommodate the guideway columns in the center of SW Avalon Way and 35th Avenue SW. Left turns would be restricted to signalized intersections. The analysis assumed that a new signal, left turn channelization for passenger vehicles, and pedestrian crosswalks could also be provided at the SW Avalon Way/SW Genesee Street intersection, which would reduce the potential for access and circulation impacts. The vehicular access restrictions caused by the placement of guideway columns in the center two-way left-turn lane are not expected to significantly affect p.m. peak hour conditions, although the left-turn prohibitions could result in some out-of-direction travel for motorists to reach their destination.

With regard to safety impacts, the introduction of guideway columns in the center of SW Avalon Way and 35th Avenue SW could result in a reduction of midblock accidents due to the elimination of left-turn movements at unsignalized intersections and driveways. Prohibiting these mid-block left turns would virtually eliminate the potential for midblock left-turn and right angle vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents. On the other hand, left-turn restrictions at unsignalized intersections and driveways could lead to increased traffic due to out-of-direction travel on parallel arterial or local access streets. There is no evidence that this would result in any impacts to safety.

The West Seattle Bridge is classified as a T-1 truck route (over 800 large trucks per day). The Preferred Alternative would not significantly affect truck circulation on these or any other roadways in the West Seattle Segment, as roadway widths and turning radii required for truck movement would be maintained.

With regard to access and circulation, traffic safety, and truck circulation impacts, the Preferred Alternative (Alternative 6.3(s)) would result in similar impacts as all of the other alternatives in the Duwamish Crossing and Delridge subsegments. In the Avalon subsegment, the Preferred Alternative (6.2.2) would result in fewer impacts than Alternative 6.1. The Preferred Alternative would also result in fewer impacts than Alternative 6.2.1 along SW Alaska Street, but could result in slightly greater impacts along 35th Avenue SW. In the Alaska Junction subsegment, impacts would be similar with the Preferred Alternative (6.1) and Alternative 6.2. In the California/Morgan Junction subsegment, impacts associated with the Preferred Alternative (6.1.6) would be similar to Alternative 6.2 and less than Alternative 6.1.

Table 4.1-52 summarizes the number of pedestrian trips expected at each station. All sidewalks evaluated within one block or 300 feet of Green Line stations would operate acceptably at LOS B or better in the years 2010 and 2020 with the Preferred Alternative. In addition, a number of bicycle facilities currently exist within 1/2-mile radius of all stations associated with the Preferred Alternative. The SMP Board has determined to provide, at initial operations, 20 bicycle spaces at the Delridge, Avalon, and Alaska Junction stations and 30 bicycle spaces at the Morgan Junction Station. Table 4.1-53 summarizes the longer-term space allocation proposed for bicycle storage at each Green Line station if bicycle demand increases.

A net loss of approximately 251 to 276 parking spaces is expected with the Preferred Alternative. A breakdown of parking losses associated with the different subsegment alignment alternatives and station alternatives associated with the Preferred Alternative is shown in Tables 4.1-54 and 4.1-55. The Green Line guideway would displace approximately 34 off-street parking stalls at Port of Seattle Terminal 25 property due to column placement. In addition, the Green Line guideway would require displacement of

approximately 25 spaces along both sides of SW Avalon Way, 22 parking spaces on the east side of 35th Avenue SW, 11 spaces on the north side of SW Alaska Street, 16 spaces on the west side of 42nd Avenue SW, and 60 parking spaces on the west side of California Avenue SW. On- and off-street parking spaces would also be displaced at switching areas on the east side of the West Seattle Bridge (up to eight off-street spaces), on California Avenue SW south of SW Edmunds Street (up to five on-street spaces), and near the Morgan Junction 1A Station (up to four on-street spaces). The Delridge 3 Station would displace no parking spaces; the Avalon 2B Station would displace approximately 23 on-street spaces along 35th Avenue SW for drop-and-drive and bus zones; the Alaska Junction 1 Station would displace the Petco parking lot (42 off-street parking spaces) and up to 23 on-street parking spaces along 42nd Avenue SW for bus zones and drop-and-drive areas; and the Morgan Junction 1A Station would displace approximately five parking spaces on California Avenue SW and three parking spaces on SW Eddy Street for bus zones and drop-and-drive areas. Parking losses associated with the Preferred Alternative are lower than all other alternatives in the Duwamish Crossing, Delridge, and Alaska subsegments. In the Avalon subsegment, the Preferred Alternative (6.2.2) would result in greater parking losses than all other alternatives. In the California/Morgan Junction subsegment, the Preferred Alternative (6.1.6(s)) would result in fewer parking losses than Alternatives 6.1 and 6.2, but would result in greater parking losses than Alternative 6.1.6.

The parking losses associated with the Preferred Alternative would not result in significant impacts to existing parking supply, since a total of 5,824 existing on-street unrestricted parking spaces are currently provided within ¼-mile radius of the station locations, and on-street unrestricted parking near the station locations is currently 26 to 43 percent used during the midday. If on-street unrestricted parking continues to be available, some hide-and-ride parking impacts could result near stations in the West Seattle Segment, since the available on-street unrestricted parking supply at all stations far exceeds the potential hide-and-ride parking demand if parking management programs are not implemented. In addition, approximately 110 existing off-street park-and-ride spaces along SW Spokane Street near the Delridge 3 station could be used by Green Line passengers. Based on midday parking utilization counts, approximately 60 percent of this available parking supply is currently used by Metro bus passengers. The Preferred Alternative would likely result in a lower potential for hide-and-ride parking impacts near the Delridge Station than all other alternatives. Mitigation measures to address parking at stations are described in Chapter 5.

4.1.2.3 Operations Center

Trip Generation

The Operations Center is expected to employ up to 200 SMP and Design-Build-Operate-Maintain contractor staff (including management, administration, operations, and maintenance staff). Because of weekend work assignments, sick leave and vacation, only 142 of the employees would work at the site on a typical weekday. If all of these employees were to drive themselves to the site, they would generate 284 commute trips per day. Trip reduction measures such as carpooling, use of transit, bicycling, or walking would likely reduce the number of trips generated by the site.

Employees would arrive and depart from the Operations Center during work shifts at different times of the day, as shown in Table 4.1-56. Based on these assumptions, up to 30 vehicle trips to the site and 83 vehicle trips from the site would be made during the p.m. peak hour.

Table 4.1-56. Operations Center Daily Number of Employees on Site – by Work Shift

Work Shift		Number of Employees per Shift
5-Day Shifts (Weekdays Only)		
8:00 a.m. to 5:00 p.m.		49
7-Day Shifts (Weekdays and Weekends)		
12:00 a.m. to 8:30 a.m.		29
8:00 a.m. to 4:30 p.m.		34
4:00 p.m. to 12:30 a.m.		30
TOTAL		142^a

Source: Lea Elliott, 2004.

^a A total of approximately 200 employees would work at the Operations Center, but because of weekend schedules, sick leave and vacation, only 142 employees would work on any given weekday.

Potential Site Alternatives

Two alternative site locations are currently being considered for the Operations Center, one in Interbay and the other in SODO.

Interbay

The Interbay alternative would place the facility on a triangular site located between 15th Avenue W, W Wheeler Street, and W Armory Way. Access for employees, mail, and small vehicle deliveries (Federal Express, etc.) would likely be provided via W Armory Way between 15th Avenue W and W Wheeler Street. Access for larger freight deliveries would be provided via W Wheeler Street between W Armory Way and 15th Avenue W.

The Interbay site is currently occupied by the Northwest Center. As described in Section 4.2 Displacements and Relocation, this current use would be displaced if the Operations Center is constructed on this site. The current use employs approximately 187 on-site employees and serves approximately 143 clients. Vehicle access to and from the existing site is currently provided via W Armory Way, and access for freight vehicles is provided via W Wheeler Street, as would be provided for the Interbay Operations Center alternative. Existing p.m. peak hour traffic count information for the 15th Avenue W/W Armory Way and 15th Avenue W/W Wheeler Street intersections suggest that approximately 111 (36 inbound, 75 outbound) trips via W Armory Way and approximately 16 (five inbound, 11 outbound) trips via W Wheeler Street are made to/from the existing use during the p.m. peak hour. As a comparison, trip generation estimates for similar warehouse/office building uses (as calculated using ITE's *Trip Generation, Sixth Edition*) suggest that 35 trips to and 116 trips from the site are generated from the existing uses during the peak hour. Therefore, both existing traffic count data and trip generation estimates based on ITE's *Trip Generation* suggest that the existing use generates more trips during the p.m. peak hour than would the Interbay Operations Center alternative. Therefore, no new traffic impacts would be expected to result from a new Operations Center located at the Interbay site.

SODO

The SODO alternative would place the Operations Center south of S Lander Street between Utah Avenue S and Colorado Avenue S. Access for employees, mail, and small deliveries (Federal Express, etc.) would likely be provided via Utah Avenue S south of S Lander Street. Access for larger freight deliveries would be provided via S Lander Street between Utah Avenue S and Colorado Avenue S.

The SODO site is currently occupied by the Home Depot and various other warehouse/light industrial uses. Vehicle access to and from the existing sites is primarily provided from S Lander Street, though some access is also provided via Utah Avenue S. Existing p.m. peak hour traffic count information for the S Lander Street/Utah Avenue S intersection indicate that approximately 526 p.m. peak hour trips (294 inbound, 232 outbound) are currently made to this area during the p.m. peak hour. Trip generation estimates for similar hardware/paint store, warehouse, and light industrial uses (as calculated using ITE's *Trip Generation, Sixth Edition*) suggest that 250 trips to and 355 trips from the site are generated from the existing uses during the p.m. peak hour. Therefore, both existing traffic count data and trip generation estimates based on ITE's *Trip Generation* suggest that the existing uses generate far more trips during the p.m. peak hour than would the Operations Center. Therefore, no new traffic impacts would be expected to result from a new Operations Center located at the SODO site.

4.1.2.4 Freight Rail Impacts

In the Interbay segment, the Green Line alignment alternatives would cross Burlington Northern Santa Fe (BNSF) tracks. In the SODO/Chinatown International District/Pioneer Square Segment, Green Line alignment alternatives would pass through a key industrial area in Seattle with substantial railroad infrastructure in place. Both Alternatives 5.1 and 5.2 would cross the BNSF mainline along the west side of Fourth Avenue S between the Weller/King Street and Safeco Field stations. Both alignment alternatives would cross the BNSF mainline tracks again north of S Lander Street between Occidental Avenue S and Third Avenue S. Along S Horton Street, both Alternative 5.1 and 5.2 would cross the BNSF tracks leading to the Seattle International Gateway (SIG) intermodal terminal and its adjacent Stacy classification and storage yard. Operation of the Green Line is not expected to affect the freight rail activity in the SODO/Chinatown International District/Pioneer Square Segment.

No adverse impacts to freight railroad activity or facilities are anticipated in any other segment of the six segments studied for the Green Line.

4.1.2.5 Navigable Waterways

Ballard Segment

All of the Green Line alternative alignments in the Ballard Segment would cross the Lake Washington Ship Canal on a new, monorail-only bridge with approximately 120 to 135 feet of vertical clearance over the shipping lanes. The precise vertical clearance will be determined by the U. S. Coast Guard. As a comparison, the vertical clearance for the I-5 Ship Canal Bridge is 127 feet and the required vertical height of the Aurora Bridge is 135 feet. Bridge piers could be located as close together as 150 feet and aligned with the existing drawbridge. The minimum main horizontal span length at the navigational channel would likely be at least 250 to 300 feet. Final navigational channel clearance will be determined by the U. S. Coast Guard.

Alternative 1.1.1 locates the new bridge approximately 40 to 50 feet to the west of the existing Ballard Bridge, and Alternative 1.1.2 locates the new bridge up to 200 feet west of the existing Ballard Bridge. Alternative 1.2 locates the new bridge approximately 50 feet east of the existing Ballard Bridge.

For all alternatives, the horizontal clearances provided would not impede maritime navigation. No less vertical clearance than existing clearances would be provided and the minimum width proposed is 250 to 300 feet. Depending on water and fisheries impacts, after consultation with the federal and state resource agencies, greater widths could possibly be implemented. Alternatives 1.1.1 and 1.2 should have no new horizontal clearance impacts. While Alternative 1.1.2 would adequately span the Ship Canal navigational channel, at least some columns for that alternative (at least one) would likely need to be located in the

existing Turning Basin at Fishermen's Terminal. Depending on exact column location, this could affect turning movements. It is expected that the column could be located to minimize these impacts (i.e., located near existing structures).

For all alternatives, vertical clearance could be provided to accommodate the reasonable needs of maritime navigation. In the exercise of its discretion, the Coast Guard would determine that vertical clearance requirement, which would range from 120 to 135 feet. Currently, almost no users require clearances greater than 115 feet, but some inconvenience could be caused for operators that would need to lower 117-foot-high cranes. The Schooner Zodiac (with full top mast) would not be able to sail under a new fixed bridge that has clearance lower than 132 feet, but the mast can be lowered to 101 feet so operations would not be prohibited. All vessels to Lake Washington are currently constrained by the I-5 Bridge (127 feet of clearance), and all vessels to Lake Union are currently constrained by the Aurora Bridge (135 feet of clearance). A bridge height for the monorail bridge that is less than these heights would impose a further potential constraint, although the interviews with maritime users indicated only one vessel (Schooner Zodiac) that would be affected by a height of 120 to 125 feet, and that vessel has a removable mast. Prior to any permit decision, the U.S. Coast Guard will seek further input from affected marine users.

The Alternative 1.1.1 and 1.2 bridge structures could block a certain portion of the tower operator's view corridor from the existing tower, which could impact navigational traffic through the Ship Canal.

West Seattle Segment

After leaving SODO, the Green Line crosses the Duwamish Waterway. With Alternative 6.1, the alignment is on top of and along the center of the existing West Seattle high-level bridge, with options for touchdown on the west end. Alternative 6.2 would cross the Duwamish Waterway on a new monorail-only bridge immediately north of the West Seattle Bridge. No impacts on horizontal navigation clearances would be created by either alternative because no new structures are proposed in water, and no permanent structures would protrude further downward from the West Seattle Bridge after construction. For the East Duwamish Waterway, Alternative 6.2 would not create navigational impacts because that waterway is already impacted by two fixed, low-level bridges for Spokane Street and railway uses. Alternative 6.1 crossing of the West Seattle Bridge at the East Duwamish Waterway would impinge on the approved navigational clearances where the existing pilings meet the existing bridge deck, because the cap beam into which those pilings connect will have to be expanded by several feet. While this affects current permit-approved clearances, it will not have a practical effect on actual navigation, because as noted above, the West Seattle Bridge across the East Waterway is flanked by fixed low-level bridges on either side that are far lower than the West Seattle Bridge.

Temporary structures could be placed in the East Waterway during construction under some construction scenarios. Over the West Waterway, no new vertical navigation clearance impact would be created because Alternative 6.1 would not lower the existing profile of the West Seattle Bridge, and Alternative 6.2 would be constructed at a vertical clearance height equal to the existing West Seattle Bridge. Temporary impacts to maritime traffic from use of construction barges in the West Waterway are discussed in Section 4.17, Construction, of this Final EIS. While no significant impediments to navigation from construction would be anticipated, construction would have to be closely coordinated with other users of the waterway, including Tribes.

4.1.2.6 Air Transportation

Ballard Segment

The three new Ship Canal bridge concepts under consideration were evaluated for the effects on flight operations through the Ship Canal flight corridor. The box girder and arch bridge alternative designs would have maximum approximate elevations of 185 feet and 210 feet, respectively. For the cable-stayed bridge alternative design, the maximum height at top of column would be an elevation of 390 feet. None of these bridge alternative designs would affect any FAA Part 77 air navigation surfaces for Boeing Field. The box girder design would have approximately 983 feet of clearance from the Part 77 surface, the arch bridge design would have approximately 958 feet of clearance from the Part 77 surface, and the highest potential cable-stayed design would have approximately 728 feet of clearance from the Part 77 surface.

The main source of air traffic above this area is the outbound floatplane traffic from the Kenmore Air Harbor floatplane base in Lake Union. There are no Part 77 surfaces related to that facility, but Kenmore Air has indicated that its flight paths through this corridor are at 500 to 1,000 feet at the Ballard Bridge location. The maximum height of any Green Line bridge would be below that elevation. The box girder design would be approximately 315 feet below the lowest elevation that Kenmore Air has indicated it uses. The arch bridge design would be approximately 290 feet below, and the highest of the cable-stayed alternative designs would be approximately 110 feet below that height. Kenmore Air has indicated its preference for one of the lower bridge heights. To ensure aircraft safety at this location, the FAA could require lighting on any of the alternative bridge designs. Steady red, low-intensity obstruction light stations (shielded in downward direction) could be required, with any final decision resting with FAA.

It is not anticipated that any of the bridge design alternatives at the Ship Canal location would have a significant adverse impact to air navigation.

West Seattle Segment

The project is not expected to result in any adverse impacts to Boeing Field, located approximately three miles south of the West Seattle Bridge. With Alternative 6.1, the alignment would place the guideway on top of and in the center of the existing West Seattle Bridge. Alternative 6.2 crosses the Duwamish Waterway on a new monorail-only bridge approximately 160 feet high. Neither structure would be expected to affect flight patterns to and from Boeing Field. Alternative 6.1 would be approximately 20 feet higher than Alternative 6.2 in this area because Alternative 6.1 would require additional elevation over the roadway surfaces as the Green Line passes over the West Seattle Bridge. An analysis of the FAA's Part 77 surfaces shows that neither alternative would affect those air navigation surfaces. The highest point of Alternative 6.1 would be approximately 148 feet below the Boeing Field approach transitional surface. At its closest point, at the edge of the approach surface, Alternative 6.1 would be approximately 112 feet below that approach surface.

4.1.3 Mitigation

This section provides potential mitigation measures to address impacts that would result from the Green Line. To improve intersection traffic operations, potential mitigation measures are discussed for locations where LOS would change from LOS E or better conditions with the No Action Alternative to LOS F conditions with the Green Line. General mitigation strategies are discussed for impacts to vehicle access and circulation, traffic safety, and parking impacts. In addition, specific concepts for improving vehicle access and circulation in locations where guideway columns would be provided in an existing center two-way left-turn lane are identified. Where applicable, opportunities to improve pedestrian and bicycle

access beyond the immediate station area, as well as locations where additional parking spaces could be provided to mitigate losses are also discussed.

4.1.3.1 Mitigation Measures Included in Project Description and Additional Mitigation Options

Many of the mitigation features included in the project description are shown in the conceptual station plans and street cross section site drawings included in Volume 2, Appendix L and Appendix LL of this Final EIS. General mitigation strategies designed to avoid or minimize potential impacts through proper design and other measures are common to all segments and are described in this category. In addition, the traffic control features and channelization assumptions that were made for conducting the traffic analysis were assumed to be part of the project description and are described for each segment.

In addition to these potential mitigation features that are included in the project description, SMP has identified additional improvements that could be considered for improving access to and from Green Line stations for all modes. The following descriptions list potential mitigation measures for each segment, including both those that are included in the project description and the additional measures that have been identified.

Common to All Segments

The project description for the Green Line incorporated a number of mitigation measures that would help ensure continued traffic flow and access. With respect to bus service, the project description anticipates that there will be proposals to truncate or redirect some existing bus routes to serve as feeder routes to Green Line stations. More detailed service implementation planning would begin one to two years before actual implementation and would involve a public process led by Metro. The delivery of bus and paratransit service, including any reorganization of service, is subject to service allocation and other guidelines from the Six-Year Transit Development Plan and to yearly budget authority as approved by the King County Council. Service Redeployment Guidelines agreed upon by Metro and Sound Transit are included in Appendix OO; Metro and SMP staff have begun working on an agreement about the planning and route modification process. A letter from Metro about this process and potential Service Redeployment is located in Appendix EE. The Green Line stations also include modified and new bus stops and layover zones close to each station to accommodate feeder bus routes.

In general, the project description anticipates that guideway columns would be placed to minimize impacts to vehicle access and circulation. This would include placing columns to avoid loading docks, retain sight distance, and maintain the space necessary to ensure that full turning maneuvers could be made into and out of site driveways. In locations where property access impacts from column placement cannot be avoided, an alternative access may be provided.

Green Line stations and guideways would be designed to comply with appropriate City standards as applicable. This could include physical separation or buffers between guideway columns and travel lanes, clear signing where left turns between columns would be restricted, and directional signs to drop-and-drive parking spaces.

To improve non-motorized access to and from station areas, SMP could work with City of Seattle staff and local community groups to place and design transit facilities to fit with local community plans. SMP is committed to providing ADA-compliant pedestrian facilities and bicycle connections at each Green Line station. Sidewalks on or immediately adjacent to SMP station property would be provided. At minimum, existing effective sidewalk widths would be maintained and any improvements would be sufficiently wide to accommodate pedestrian volumes from the project and would be designed to conform

to applicable City standards. With respect to bicycle facilities, SMP would design stations to provide ample space for maneuvering bicycles in and through stations. Bicycle parking areas would be provided at stations ranging from 250 to 1,000 square feet of site area.

The potential for hide-and-ride parking and the best ways to mitigate the impact are unique to each individual station area. SMP would work with City of Seattle staff and neighborhood organizations to identify and implement parking management strategies that meet each neighborhood's desired balance of residential, business, customer, and employee parking. The approach could include conducting additional parking surveys of on-street unrestricted parking supply within station areas where significant potential for hide-and-ride activity exists. The parking surveys could occur approximately six months to one year before the Green Line opens to determine whether parking utilization is increasing as a result of the Green Line. SMP would work with City staff to determine the specific parking study methodology closer to station opening. Potential mitigation measures to consider before the Green Line opens could include new or expanded residential parking zones (RPZs), hourly and day of week parking restrictions, parking meters, monitoring of use, enforcement, and public education campaigns. RPZs are generally applicable on residential streets with greater than 75 percent parking utilization.

Ballard Segment: Mitigation Measures Included in Project Description

Alternative 1.1 or 1.1(s) would displace the southbound off-peak parking/peak travel lane on 15th Avenue NW due to the placement of the guideway on the west side of the street. No new signals were assumed to be provided along 15th Avenue NW to maintain vehicular access and circulation in this segment.

Alternative 1.2 could result in vehicular access restrictions at unsignalized intersections and driveways caused by placement of guideway columns in the existing center two-way left-turn lane on 15th Avenue NW. Impacts resulting from these access restrictions could be mitigated by signalizing the NW 83rd Street and NW 63rd Street intersections and allowing left turn movements for passenger vehicles in the northbound and southbound directions. In addition, left-turn movements could be retained at the following signalized intersections on 15th Avenue NW: NW 85th Street, NW 80th Street, NW 75th Street, NW 70th Street, NW 67th Street, NW 65th Street, NW 60th Street, and NW 58th Street. Providing new signalized intersections with crosswalks at the NW 83rd Street/15th Avenue NW and NW 63rd Street/15th Avenue NW intersections with Alternative 1.2 would also improve pedestrian access to and from the Crown Hill 2 and NW 65th stations.

Existing travel lane widths and turning radii required for truck movement through this corridor could be maintained, as 15th Avenue NW is a major truck street in the City of Seattle.

With Alternative 1.1 or 1.1(s), parking impacts on the west side of 15th Avenue NW could be minimized by providing parking between guideway columns. This could potentially result in a gain of up to 45 new parking spaces on the west side of the 15th Avenue NW south of NW 65th Street. With Alternative 1.2, an additional 10 parking spaces could be gained on the east side of 15th Avenue NW between NW 53rd and NW 52nd Streets.

The potential for hide-and-ride parking impacts exists in the Ballard Segment, particularly near the Crown Hill station, which would serve as the Green Line's northern terminus. Mitigation for potential hide-and-ride activity could be a high priority for the City of Seattle and the Ballard community. Some replacement parking could be identified for parking losses along 15th Avenue NW for all alternatives.

Ballard Segment: Potential Additional Mitigation Measures

The following measures could be considered for mitigating future LOS F conditions resulting from project trips and/or traffic revisions associated with Alternative 1.1:

- The 15th Avenue NW/NW 80th Street intersection could require mitigation due to its anticipated LOS F condition during the p.m. peak hour in 2020, compared with LOS E for the No Action Alternative. The addition of a westbound right turn lane or pocket and signal optimization would return this intersection to LOS E conditions with an average delay of 74.4 seconds per vehicle during the p.m. peak hour.

The following measures could be considered for mitigating future LOS F conditions resulting from project trips and/or traffic revisions associated with Alternative 1.2:

- For Alternative 1.2, the 15th Avenue NW/NW 85th Street and 15th Avenue NW/NW 80th Street intersections could require mitigation due to their LOS F condition in 2010 and 2020. Due to the reduced number of through travel lanes on 15th Avenue NW at these intersections, optimizing the signal timing plans for these two intersections would not mitigate the change in conditions. Restoring the northbound right turn lane at the 15th Avenue NW/NW 85th Street intersection would return intersection operations to conditions similar to the No Action Alternative. At the 15th Avenue NW/NW 85th Street intersection, the addition of a northbound right turn lane and westbound right turn lane would improve intersection operations to LOS E in the year 2020.
- At the 15th Avenue NW/NW Market Street intersection, restoring the northbound right-turn pocket or lane would mitigate the reduced northbound capacity with Alternative 1.2, resulting in operations similar to the No Action Alternative in the year 2020.

The following improvement could be considered for mitigating future LOS F conditions resulting from project trips and/or traffic revisions associated with both alternatives:

- During the a.m. peak hour, the eastbound approach of the unsignalized 15th Avenue NW/NW Holman Road intersection is projected to operate at LOS F during the a.m. peak hour in 2020. At this intersection, the stop-controlled eastbound right-turn movement is the critical movement. The delay for this approach would be the same for both alignment alternatives and the two Crown Hill station alternatives. However, the LOS F conditions are pre-existing conditions. A traffic signal could be warranted even for existing conditions using the Manual on Uniform Traffic Control Devices (MUTCD) Peak Hour Warrant. Signalizing the intersection would improve overall intersection operations to LOS B in the year 2020. This does not assume signalization of the Petco Driveway approach.

Where additional intersection improvements are discussed, SMP's contribution could be determined by its ratio of impacts or other equitable method.

Sidewalks currently exist within ¼-mile radius of most stations in the Ballard Segment. However, a sidewalk segment is currently missing on one side of NW 85th Street between 15th Avenue NW and 18th Avenue NW. The project could benefit from sidewalk improvements along this segment of roadway. In addition, the north leg of the NW 87th Street/15th Avenue NW intersection could be clearly restriped to indicate the presence of a crosswalk.

Adequate bicycle connections currently exist in all directions from the stations. However, the project could benefit from improved bicycle facilities on 15th Avenue NW between NW 65th Street and the Crown Hill station.

Interbay/Magnolia Segment: Mitigation Measures Included in Project Description

With Alternative 2.1 or 2.1(s), vehicular access impacts could result from placement of columns in the existing center two-way turn lane on Elliott Avenue W. Impacts resulting from turn restrictions at unsignalized intersections and driveways could be minimized by providing a new signal and allowing for

protected turn movements at the Elliott Avenue W/W Lee Street intersection. Left-turn movements could also be retained at the following signalized intersections: W Garfield Street, Galer Street flyover, W Prospect Street, W Mercer Place, and W Mercer Street. U-turns could also be permitted for passenger vehicles and single-unit delivery vehicles at the W Prospect Street, W Mercer Place, and W Mercer Street signalized intersections to minimize the impact of left-turn restrictions at unsignalized intersections and driveways. Providing a new signalized intersection with crosswalks at the Elliott Avenue W/W Lee Street intersection with Alternatives 2.1 or 2.1(s) would also improve pedestrian access in this segment.

With Alternative 2.2, a new signal could be provided at W Armour Street and left and U-turn movements permitted to mitigate potential vehicular access restrictions along 15th Avenue W. Left-turn movements could also be retained at the Gilman Drive W and W Armory Way signalized intersections. U-turns could be permitted for passenger vehicles at all three signalized intersections to minimize the impact of left-turn restrictions at unsignalized intersections and driveways. Providing a new signalized intersection with crosswalks at the 15th Avenue W/W Armour Street intersection with Alternative 2.2 could also improve pedestrian access in this segment.

Existing travel lane widths and turning radii required for truck movement through this corridor could be maintained, as 15th Avenue W and Elliott Avenue W are both major truck streets in the City of Seattle.

A pedestrian signal and crosswalks are currently not provided at the 16th Avenue W/W Dravus Street intersection. The Dravus 1 and 1A station options would locate the station platform on the northwest quadrant of this intersection and thus attract pedestrian trips to this intersection. The Dravus 1B station option would be located on the southeast quadrant of this intersection, and would also attract pedestrian trips to this intersection. The Dravus 2 station option would locate the station northeast of this intersection. Providing a pedestrian or full traffic signal and north-south crosswalk at the west (Dravus 1 and 1A) or east (Dravus 1B and 2) leg of the 16th Avenue W/W Dravus Street intersection could safely serve Green Line passengers traveling to the Dravus station from either the south or north side of W Dravus Street.

A signalized intersection with a crosswalk could be provided at the W Newton Street intersection. This new signal could help serve pedestrians accessing the Howe and Prospect stations.

An elevated pedestrian crossing could be provided at the Sixth Avenue W/W Mercer Street intersection. This crossing could serve pedestrians accessing the Elliott and Mercer station from the east.

Based on existing parking utilization rates and projected auto access trips, some potential for hide-and-ride parking impacts exists in the Interbay/Magnolia Segment, particularly near the Dravus station, which could attract riders from residential neighborhoods east and west of the station and beyond a ¼-mile walking distance of the stations. SMP would work with the City of Seattle to determine whether mitigation for potential hide-and-ride activity would be a high priority for this neighborhood.

Interbay/Magnolia Segment: Potential Additional Mitigation Measures

The W Dravus Street/16th Avenue W, W Dravus Street/15th Avenue W ramp terminal intersections, 15th Avenue W/W Armour Street, and 15th Avenue W/W Wheeler Street intersections could require mitigation for at least one of the Green Line alternatives due to the intersection's anticipated change from projected 2020 No Action conditions. The following measures could be considered for mitigating future LOS F conditions resulting from project trips and/or traffic revisions associated with the Green Line alternatives in the Interbay/Magnolia Segment:

- At the W Dravus Street/16th Avenue W intersection, potential mitigation for Alternative 2.1 or 2.1(s) could involve providing a southbound right-turn pocket on 16th Avenue W to allow right-

turning vehicles to turn past those waiting to make a left turn. With this improvement, the intersection would continue to operate at LOS F; however, the approach delay would improve to 101.0 seconds per vehicle, which is better than 2020 No Action by 36.1 seconds per vehicle. With Alternative 2.2, this improvement would not sufficiently mitigate intersection operations; however, installing a two-phase signal instead could improve intersection operations to LOS A conditions. This would allow for noticeably better operations for turning movements from the side street approaches. Alternative 2.2 could require greater mitigation due to the location of Dravus 2 option, which would promote a higher use of the stop-controlled 16th Avenue W southbound approach at W Dravus Street. It should be noted that the need for a pedestrian crossing was identified in the non-motorized analysis and a traffic signal would be capable of providing a controlled pedestrian crossing for Alternative 2.1, 2.1(s), or 2.2.

- At the 15th Avenue W ramp terminal intersections with W Dravus Street, potential mitigation for either Green Line alignment and station alternative could consist of using a signal timing plan for the p.m. peak hour rather than allowing the signals to operate as all-way stop controlled intersections. The a.m. peak hour timing plan currently in place would sufficiently mitigate the LOS conditions if applied to the p.m. peak hour. LOS conditions would improve to LOS C from LOS F conditions for Alternatives 2.1, 2.1(s), or 2.2. For Alternative 2.1 and 2.1(s), the signal operations would result in an intersection delay at the northbound ramps intersection of 27.3 seconds per vehicle and 28.4 seconds per vehicle at the southbound ramps. For Alternative 2.2, the signal operations would result in an intersection delay at the northbound ramps intersection of 27.1 seconds per vehicle and 29.3 seconds per vehicle at the southbound ramps.
- At the 15th Avenue W/Armour Street and 15th Avenue W/W Wheeler Street intersections, side street vehicle movements would continue to experience very high delays due to the difficulty in turning left or traveling across the intersections from the side streets. Alternatives 2.1 or 2.1(s) do not assume any improvements to the 15th Avenue W/W Armour Street intersection; however, Alternative 2.2 assumes signalization of this intersection. Additionally, Alternatives 2.1 and 2.1(s) do not assume any side street turning movement restrictions to the 15th Avenue W/W Wheeler Street intersection; however, Alternative 2.2 assumes restriction of the vehicle movements to/from the side street to right-turn only. For Alternatives 2.1 and 2.1(s) in the year 2020, either assuming what Alternative 2.2 has assumed for improvements, or widening the side street approaches for a left-turn lane could reduce the delays at these intersections. Widening the side street approaches would still result in the LOS F conditions; however, the delays would reduce substantially, for instance, as much as 140 seconds per vehicle for the westbound W Wheeler Street approach to 15th Avenue W. Vehicle delays would also be reduced at W Armour Street (the delay is not calculated for No Action because the volume to capacity ratio is too high). Alternatively, using the intersection modifications included in Alternatives 2.1 and 2.1(s) at W Armour Street and W Wheeler Street, the worst approach at W Wheeler Street could operate at LOS C with 18.2 seconds of delay, and the signalized W Armour Street intersection could operate at LOS A with a delay of 6.2 seconds per vehicle. In either case, the results would be better than the 2020 No Action Alternative LOS.
- At the Elliott Avenue W/W Mercer Place intersection, the elimination of a northbound through lane with Alternative 2.1 or 2.1(s) would result in a change from LOS C with the No Action Alternative to LOS F in both the years 2010 and 2020 during the p.m. peak hour. Rechannelizing the eastbound approach to provide right turns only and removing the eastbound signal phase would improve intersection operations to LOS E in the year 2020. Intersection operations would further improve to LOS C conditions if the northbound travel lane is maintained at this intersection. This could be possible if northbound left/U-turns are redirected to the Elliott Avenue W/W Prospect Street intersection.

Where additional intersection improvements are discussed, SMP's contribution could be determined by its ratio of impacts or other equitable method.

A number of local streets within a 1/2-mile radius of the station alternatives currently lack sidewalks on one or both sides. Priority should be given to the improvement of sidewalks along arterial streets nearest to the station alternatives, such as along 15th Avenue W at the W Dravus Street northbound and southbound ramps, along 15th Avenue W between W Barrett Street and W Armour Street, at the east end of the Magnolia Bridge, on Elliott Avenue W between W Lee Street and W Prospect Street, and on W Mercer Place between Elliott Avenue W and W Mercer Street. The following locations are also in need of curb ramps to improve nonmotorized access to the Dravus station:

- W Dravus Street/16th Avenue W Southbound Ramps – The southwest and southeast corners of this intersection lacks curb ramps; however, SDOT has identified funding and is preparing to install curb ramps at this location in 2003.
- W Dravus Street/15th Avenue W Northbound Ramps – All corners of this intersection currently lack curb ramps.
- W Dravus Street/17th Avenue W – The southwest corner of the intersection currently lacks curb ramps.

Queen Anne/Seattle Center/Belltown Segment: Mitigation Measures Included in Project Description

With Alternatives 3.3 and 3.5, there is some potential for truck circulation impacts along Thomas Street south of Key Arena, where the guideway columns would need to be carefully placed to minimize impacts to turning movements in and out of loading docks.

With Alternative 3.1.4, up to 20 new parking spaces could be added between guideway columns on Fifth Avenue N to partially minimize parking losses.

Queen Anne/Seattle Center/Belltown Segment: Potential Additional Mitigation Measures

With Alternative 3.5, the following measures could be considered for mitigating future LOS F conditions resulting from the removal of the eastbound curb lane on Denny Way:

- During the p.m. peak hour, the Denny Way/Broad Street intersection would change from LOS D with the No Action Alternative to LOS F with Alternative 3.5 in the year 2020 due to the elimination of the second eastbound travel lane on Denny Way. By optimizing signal timing, intersection operations could improve to LOS E with Alternative 3.5 in the year 2020. To improve intersection operations to better than No Action conditions, an additional turn lane could be added. For instance, the addition of a second southbound right turn lane could improve intersection operations to LOS D with Alternative 3.5. However, the addition of this right turn lane would likely result in property impacts.
- During the a.m. peak hour, the Denny Way/Fifth Avenue intersection would change from LOS C with the No Action Alternative to LOS F (104.6 seconds of delay per vehicle) with Alternative 3.5 in the year 2020 due to the removal of the eastbound curb lane on Denny Way. To improve intersection operations, an exclusive southbound left turn lane could be added, and the intersection signal timings would need to be optimized. These changes would improve intersection operations to LOS D (54.5 seconds of delay per vehicle). However, the addition of this southbound left turn lane would likely result in property impacts.

Where additional intersection improvements are discussed, SMP's contribution could be determined by its ratio of impacts or other equitable method.

Downtown/Pioneer Square Segment: Mitigation Measures Included in Project Description

With the Fifth and Stewart station alternatives, an elevated walkway could be provided to improve pedestrian access between the station and Westlake Center. This would provide Green Line patrons with a direct pedestrian connection to and from the Downtown Seattle Transit Tunnel.

Widening the sidewalk on Second Avenue between Pike and Union Streets could improve pedestrian circulation to and from the Pike 2 station.

With Alternatives 4.1 and 4.2, the analysis assumed that the sidewalk width on Stewart Street could be 12 or 13 feet on the north side and increased from 12 feet to 18 feet on the south side. This would allow pedestrians to circulate more freely through the area.

With Alternatives 4.1 and 4.2 (south of Marion Street), all-day parking could be provided between columns on the west side of Second Avenue, except where bus stops are located, to minimize parking losses. With Alternative 4.2 (north of Marion Street), all-day parking could be provided between columns on the east side of the street.

Table 4.1-57. Level of Service Comparison – Three vs. Two General-Purpose Lanes on Second Avenue

Intersection	Existing	No Action	Year 2010		No Action	Year 2020	
			Second Avenue - 3 GP Lanes	Second Avenue - 2 GP Lanes ^a		Second Avenue - 3 GP Lanes	Second Avenue - 2 GP Lanes ^a
Second Avenue/Stewart Street	B (11.5)	B (12.0)	B (12.4)	B (15.0)	B (11.3)	B (13.2)	B (16.3)
Second Avenue/Pine Street	A (7.8)	A (7.8)	A (8.1)	A (8.8)	A (8.2)	A (8.6)	A (9.7)
Second Avenue/Pike Street	B (12.7)	B (13.8)	B (11.8)	B (14.7)	B (15.8)	B (13.0)	B (17.5)
Second Avenue/Union Street	B (10.8)	B (11.4)	B (11.4)	B (12.0)	B (12.2)	B (11.9)	B (12.9)
Second Avenue/University Street	A (8.1)	A (8.2)	A (8.9)	B (11.2)	A (8.9)	A (9.5)	B (14.0)
Second Avenue/Seneca Street	B (10.6)	B (11.0)	B (11.0)	B (13.1)	B (11.8)	B (11.7)	B (15.6)
Second Avenue/Spring Street	B (12.9)	B (13.8)	B (13.7)	D (47.5)	B (14.0)	B (13.9)	E (59.8)
Second Avenue/Madison Street	B (16.6)	B (17.0)	B (16.8)	B (19.2)	B (17.5)	B (17.3)	C (20.2)
Second Avenue/Marion Street	A (6.8)	A (6.9)	A (6.8)	B (11.9)	A (6.9)	A (6.8)	B (14.3)
Second Avenue/Columbia Street	E (75.0)	F (84.6)	E (72.1)	E (71.6)	F (97.5)	F (85.5)	F (85.2)
Second Avenue/Cherry Street	A (6.8)	A (6.6)	A (6.7)	A (7.8)	A (6.7)	A (6.7)	A (8.3)
Second Avenue/James Street	C (28.0)	D (36.2)	C (28.2)	C (27.0)	D (42.0)	D (33.5)	C (32.1)
Second Avenue/Yesler Way	B (17.0)	B (18.6)	B (18.3)	C (22.3)	B (19.5)	B (19.0)	C (30.8)

^a The results shown for this analysis would also apply to a mitigation option suggested for Alternative 4.3 that would remove a general purpose traffic lane instead of removing a bicycle lane.

As shown in Table 4.1-57, several intersections would degrade slightly compared to other alternatives and No Action if a general traffic lane was removed from Second Avenue. The level of service at degraded intersections, such as Second Ave/Spring St could be improved by allowing more green time along Second Avenue, the figures in Table 4.1-57 makes the same assumptions as for all other EIS traffic analysis on Second Avenue in order to make comparisons easier. Even though level of service could be mitigated, the City of Seattle has indicated a lack of interest in this refinement both because of the loss of the general purpose traffic lane and because of the loss of the bicycle lane in the street cross-section.

SODO/Chinatown International District/Pioneer Square Segment: Mitigation Measures Included in Project Description

The general mitigation strategies described for careful design and placement of guideway columns would apply to the SODO/Chinatown International District/Pioneer Square Segment. Due to the proximity of the Green Line alternatives to major truck routes and loading docks, SMP would need to work closely with area businesses to minimize any potential impacts to truck access and circulation. Special long span structures will be used in several areas to mitigate impacts to railroads and to allow for easier truck turning movements.

SODO/Chinatown International District/Pioneer Square Segment: Potential Additional Mitigation Measures

Near the Safeco station, sidewalks are currently missing on Third Avenue S between S Royal Brougham Way and S Massachusetts Street and on S Atlantic Street between Third Avenue S and Fourth Avenue S. There are also missing sidewalk segments near the Lander station alternatives, most notably on Occidental Avenue S between S Stacey and S Forest Streets, on S Forest Street between First Avenue S and Occidental Avenue S, and on Utah Avenue S between S Stacey Street and S Forest Street. Pedestrian access to and from the stations could be enhanced by providing continuous sidewalks in these areas. However, SMP is not responsible for making improvements beyond the immediate station areas.

Currently, there are only two designated east-west bicycle routes near the King Street station, which are located on S Jackson Street, and S Dearborn Street. Identification of new east-west bicycle routes south of S Dearborn Street could help serve bicycle commuters traveling between either the Safeco Field or Lander stations and surrounding areas.

West Seattle Segment: Mitigation Measures Included in Project Description

Alternative 6.1 could result in vehicular access restrictions at unsignalized intersections and driveways on SW Avalon Way and California Avenue SW, due to the placement of guideway columns in the center of these streets. On SW Avalon Way, a new traffic signal could be provided at the SW Avalon Way/SW Genesee Street intersection to provide an opportunity for passenger vehicles to make left turns. On California Avenue SW, left-turn movements could be retained at the SW Graham Street/California Avenue SW intersection. In addition, new traffic signals, left-turn opportunities, and pedestrian crosswalks could be provided at the following intersections along California Avenue SW: SW Brandon Street, SW Findlay Street, SW Juneau Street, and SW Raymond Street. Providing new signalized intersections with crosswalks on SW Avalon Way and California Avenue SW would also improve pedestrian access to and from the Green Line stations.

With Alternative 6.2, vehicular access restrictions at unsignalized intersections and driveways could result from the placement of columns in the existing center two-way left-turn lane on SW Avalon Way and in the center of SW Alaska Street. A new traffic signal could be provided at the SW Avalon Way/SW Genesee Street intersection to provide an opportunity for passenger vehicles to make left turns on SW Avalon Way. On SW Alaska Street, vehicles could be permitted to make left turns from SW Alaska Street at the following existing signalized locations: 35th Avenue SW, 39th Avenue SW/Fauntleroy Way SW, 42nd Avenue SW, and California Avenue SW. Providing a new signalized intersection with crosswalks at the SW Avalon Way/SW Genesee Street intersection could also improve pedestrian access to and from the Green Line stations.

With Alternative 6.1, parking impacts could be minimized by providing new parking spaces between columns on the west side of Delridge Way SW (up to 27 spaces), on Fauntleroy Way between 38th

Avenue SW and SW Alaska Street (up to 11 spaces), and on SW Alaska Street between 41st and 42nd Avenues SW (up to five spaces).

A high potential for hide-and-ride parking impacts exists in the West Seattle Segment, particularly near the Morgan Junction station, which would serve as the Green Line's southern terminus, and at the Delridge station, which would provide the most direct access via auto from areas south and east of the Green Line alternatives. Mitigation for potential hide-and-ride activity could be a high priority for the City of Seattle and the West Seattle community. Mitigation measures are discussed in Chapter 5.

West Seattle Segment: Potential Additional Mitigation Measures

In the West Seattle Segment, transportation impacts are anticipated to occur at three intersections. The following measures could be considered for mitigating future LOS F conditions resulting from project trips and/or traffic revisions associated with the Green Line alternatives in the West Seattle Segment:

- With Alternative 6.1, the Avalon 1 (Center) station alternative would displace a travel lane on 35th Avenue SW and SW Avalon Way due to transit stops and layover zones and drop and drive space for the station. These features could affect traffic operations at the Fauntleroy Way SW/SW Avalon Way and 35th Avenue SW/SW Avalon Way intersections, causing intersection level of service to drop from LOS A to LOS C and LOS B to LOS D, respectively. The intersection LOS results are an indicator of increased congestion as a result of the on-street station features for buses and drop-and-drive. To reduce the potential impacts to these arterials and traffic operations, alternate locations could be identified for the transit layover and drop and drive components of the Avalon 1 (Center) station alternative.
- With both Alternatives 6.1 and 6.2, a new traffic signal could be provided at the SW Avalon Way/SW Genesee Street intersection to facilitate left turn movements with a center alignment along SW Avalon Way. The proposed traffic signal would improve p.m. peak hour No Action LOS F operations to LOS C in the year 2020 with either alternative.
- Alternative 6.1 could also benefit from a new traffic signal at the California Avenue SW/SW Brandon Street intersection. This new traffic signal could facilitate left turn movements on California Avenue SW with a center alignment. Signalization of this intersection could improve p.m. peak hour intersection operations from LOS F with the No Action Alternative to LOS A in the years 2010 and 2020.

Where additional intersection improvements are discussed, SMP's contribution could be determined by its ratio of impacts or other equitable method.

With Alternative 6.3(s), various bus routing options could be considered along Spokane Street to improve bus access to and from the Delridge 3 Station. Options could include signalization and/or channelization improvements at the SW Spokane Street/26th Avenue SW intersection, and intersection/grading improvements to the SW Spokane Street/West Seattle Bridge on-ramp and SW Spokane Street/Delridge Way SW intersections.

With Alternative 6.1, impacts to vehicular access restrictions at unsignalized intersections and driveways on California Avenue SW, due to the placement of guideway columns in the center of the street, could be minimized with the addition of new traffic signals and left turn opportunities, as described in the Mitigation Features Included in Project Description section above. Sidewalks are provided along all major arterials within a ¼-mile radius of the four West Seattle stations. However, curb ramps are missing on the south side of Fauntleroy Way SW at the Fauntleroy Way SW/SW Oregon Street intersection and at all corners of the Fauntleroy Way SW/38th Avenue SW intersection. Curb ramps could be provided to

improve nonmotorized access to the Avalon station. No new bicycle routes are needed in the West Seattle Segment to adequately serve the stations.

4.1.3.2 Freight Rail

The project would result in no impacts to freight rail activity, since guideways would meet or exceed applicable standards for clearance over railroad tracks and facilities in the SODO/Chinatown International District/Pioneer Square Segment. Therefore, no mitigation would be required.

4.1.3.3 Navigable Waterways

New structures across the Ship Canal for all alternatives (1.1.1, 1.1.2, and 1.2) in the Ballard Segment would meet or exceed applicable standards for the reasonable uses of maritime navigation. However, with Alternative 1.1.2, bridge piers south of the Ship Canal channel would need to be placed to avoid or minimize impacts to the existing turning basin located west of the Ballard Bridge. Bridge operator sight lines for the existing Ballard Bridge operating tower should also be considered during the design of column locations for the new Ballard Crossing for the Green Line.

In the West Seattle Segment, new or modified structures across the Duwamish Waterway in both alternatives would meet or exceed applicable standards for clearance over navigable waterways, and conceptual designs avoid impacts to navigable waterways. Therefore, no mitigation would be required. SMP will coordinate with the U. S. Coast Guard, maritime users, and Tribes through design and construction. If a new monorail-only bridge is constructed, bridge operator sight lines for the existing Spokane Street Swing Bridge will be considered during the design of column locations for the new Green Line bridge. If temporary structures are placed in the East Waterway during construction, as could be the case under some scenarios, SMP would work with the U.S. Coast Guard and other organizations and agencies to develop any needed mitigation measures.

4.1.3.4 Air Transportation

The FAA could require low-intensity obstruction lighting on any bridge elements for the new Green Line bridge across the Ship Canal as mitigation for any potential conflicts with aircraft.

4.1.4 Significant Unavoidable Adverse Impacts

The loss of on-street parking spaces on Second Avenue and off-street parking lots on Fifth Avenue, Pine Street, Second Avenue, and First Avenue in the Downtown/Pioneer Square Segment, associated with Alternatives 4.1, 4.2, 4.3, and 4.4 could be considered a significant unavoidable adverse impact. This parking impact would be the greatest for Alternative 4.3, which could displace approximately 236 on-street and 1,179 to 1,240 off-street parking spaces. Alternative 4.4 could displace approximately 236 on-street and 447 off-street parking spaces. Alternative 4.2 could displace approximately 122 on-street and 500 off-street parking spaces, and Alternative 4.1 could displace approximately 185 on-street and 282 to 359 off-street parking spaces. There are no significant unavoidable adverse transportation or parking impacts from any other Green Line alternative alignments.

These parking losses may be unavoidable, but it should be noted that they will be lost in the context of providing a new transit alternative that will provide quick and convenient access to Downtown businesses, shops, restaurants, and attractions every day. Alternative 4.1, the Preferred Alternative, would have the least parking impact on the Downtown area compared to other alternatives.

4.2 DISPLACEMENTS AND RELOCATION

This section provides estimates of the number and locations of properties that could be acquired for constructing and operating the Green Line, and discusses the uses that could be displaced. Property acquisition data are provided for each Green Line alignment and station alternative by type of land use (e.g., residential, commercial/industrial, public/institutional) based on field surveys and King County Assessor's data. Properties required for the development of the Green Line alternative were provided by SMP staff, and updated for this Final EIS (SMP 2003). This section also incorporates information presented in the Seattle Popular Transit Plan Programmatic EIS (ETC 2002). Final decisions about property acquisition and displacements will continue during final design and construction; the estimates presented in this Final EIS are approximations based on conservative station footprints and alignment drawings for each alternative analyzed.

SMP has adopted Resolution 03-33, Real Property Acquisition and Relocation Policies, Procedures, and Guidelines, to provide consistent treatment, minimize hardship of persons and businesses relocated as a direct result of the project, and seek cooperative settlements of property acquisitions and relocation claims. SMP determined that this policy could be an appropriate way to ensure fair treatment of individuals and businesses affected by the Green Line. As stated in the policy, "The Seattle Monorail Project affirmatively elects to provide relocation assistance and benefits to all displaced persons and businesses as provided in [Revised Code of Washington] RCW 8.26.010 through 8.26.115." SMP has adopted the Uniform Relocation Assistance program set forth in Washington Administrative Code (WAC) 468-100. The Green Line would not be built with federal funds, and federal relocation requirements do not apply.

4.2.1 Affected Environment

The ease of relocating individuals and businesses depends in part on the vacancy rates for residential and commercial/industrial properties, although SMP's policy commitment would provide relocation assistance and benefits to displaced parties regardless of prevailing vacancy rates. Typically, vacancy rates of 2 percent or lower indicate that the removal of units from area supply could aggravate supply shortages.

In 2000, total residential vacancy in Seattle was 12,026 housing units or approximately 4.7 percent. There were 5,101 units for rent, 2,011 units for sale, and the remainder unoccupied or for occasional use only (U.S. Census Bureau, Census 2000). Since 2000, however, residential vacancy rates have increased due to the economic slowdown. The CB Richard Ellis Second Half of 2002 Market Index Brief (CB Richard Ellis 2003a) shows an apartment vacancy rate of 8.4 percent for Seattle overall,¹ or over 3 percent higher than in 2000. The generally accepted equilibrium vacancy rate (where neither landlords nor tenants have disproportionate market power) is 5 percent, with Seattle's residential vacancy rate in late 2002 3.4 percent over this equilibrium level (CB Richard Ellis 2003a).

Commercial vacancy rates in the Puget Sound region also continue to be high. As of the fourth quarter of 2002, the vacancy rate was 7.2 percent in the North End (an area from the Ship Canal north to Snohomish County), 15.4 percent in Downtown Seattle (from the Ship Canal south to Pioneer Square), and 16.9 percent in the South End (from South Downtown to Auburn) (Economic Development Council of Seattle and King County 2003).

New commercial construction activity also has declined region-wide. For example, Downtown Seattle had 362,600 square feet of commercial construction during the first quarter of 2003, compared to 965,600 square feet during the fourth quarter of 2002 (CB Richard Ellis 2003b). The abundance of vacant commercial properties in the Puget Sound market is leading landlords to reduce rents in order to attract new tenants or

¹ No gross numbers of units are cited because the rate is based on a sample of the market.

retain existing tenants (CB Richard Ellis 2003b). The Downtown Seattle submarket was the exception, where rental rates increased by a modest 1.7 percent during 2002 (CB Richard Ellis 2003b).

The Seattle industrial real estate market consists of 70,114,792 square feet of gross leasable area (34 percent of the Puget Sound total). While Seattle industrial vacancy rates typically are low, the industrial market experienced a rise in vacancies from 2.19 percent to 5 percent during the first quarter of 2003.

Industrial growth has also decelerated throughout the Puget Sound region. In the first quarter of 2003, a total of 87,600 square feet was under construction, compared to 1.5 million square feet during the same quarter in 2002 (CB Richard Ellis 2003c). During the first quarter of 2003, average asking lease rates fell 9.2 percent for industrial space (CB Richard Ellis 2003c). A more detailed characterization of the land use characteristics along the Green Line was provided in the DEIS Section 4.3, Land Use and Neighborhoods Affected Environment.

4.2.2 Impacts

4.2.2.1 System-Level Impacts

The Green Line is planned to run primarily above the public right-of-way and will therefore require relatively few full property acquisitions or displacements of existing land uses given its 14-mile length. This section discusses impacts anticipated to result from properties acquired for construction or operation of the Green Line.

Not all real estate properties to be acquired for the Green Line would need to be fully acquired, and this section discusses the numbers of properties to be acquired by full or partial acquisition. Full acquisitions occur if the project requires use of the entire parcel or may occur when the project substantially interferes with or requires the removal of a structure integral to the property's use, makes the property unusable, or denies access to the property. Partial acquisitions occur when the portion of the property to be acquired would not substantially interfere with or impair the use of the entire site, and the unused portion of the site remains viable. In cases where the guideway travels above a property (air rights acquisition), or land is required for a guideway column or special column structure (such as a bent), or access across a property is required, a portion of the property would be required to accommodate these design features and activities.

Property acquisitions discussed in this document are preliminary and conservatively high estimates. Property acquisitions (including determination about whether the property would involve a full or partial acquisition or other compensation or agreement) are anticipated to be finalized after an alternative for the Green Line is selected, and negotiations between individual property owners and SMP have concluded. All qualified displaced businesses and residents will be provided with relocation assistance.

The permanent property acquisition impacts described below are anticipated to be needed to operate the Green Line. Construction staging areas also could be needed for temporary use; these areas may not be identified until after the design-build contractor for the Green Line has been selected but are discussed in Section 4.17, Construction. After construction is complete, SMP could sell excess property.

Depending on the alignment and station alternatives selected for the Green Line, different numbers and types of properties could need to be acquired. Table 4.2-1 summarizes these possible property acquisitions by segment and alternative. Depending on the alternatives selected, up to 107 parcels could be acquired partially and 39 to 79 could be fully acquired. Impacts of property acquisition are anticipated to be concentrated on commercial/industrial properties; up to 61 of these types of properties are estimated to be fully acquired depending on the alternatives.

In addition to the property acquisitions for alignment, station, and operations center alternatives, a number of properties might be utilized for traction power substations. Between 10 and 20 substations would be required, and some might be incorporated into stations or guideways or co-located with other uses. These substations would be small utility transfer uses, with buildings ranging from approximately 1,200 to 2,100 square feet in size, although property sizes could be higher. Both the location and number of traction power substations would be flexible (refer to Chapter 3 for a description of traction power substations). Because substations would be small and would be distributed along the full alignment, they are not anticipated to cause significant acquisition or displacement impacts, or to cause dissimilar impacts between areas.

The estimates for property acquisitions include up to eight properties for one to two sets of pocket tracks to be located in the Queen Anne/Seattle Center/Belltown and SODO Segments; the exact locations of these pocket tracks are also flexible (refer to Chapter 3 for description of pocket tracks). Switches may also be required in a number of locations throughout the alignment; in most cases, switches would require air rights acquisitions only.

Regardless of the combination of segment alternatives chosen for the project, displacement impacts on both single-family and multifamily residences would be low (between zero and twelve single-family parcels and between zero and five multifamily properties). For public or institutionally owned parcels, three full acquisitions could occur. Table 4.2-2 provides a more detailed listing of potential parcel acquisitions by segment and alternative. A summary of potentially displaced businesses and household units is provided in Table 4.2-3. A table (Table 4.4-1) identifying the number of potentially displaced business enterprises along with the estimated number of employees is found in Section 4.4, Economics. Estimates of the number of employees that would be displaced from businesses are based on business type and square footage, an estimation methodology determined to be sufficiently conservative for this type of analysis.

For each segment alternative, the estimates of property acquisition, displacement and relocation effects reflect a representative selection of the stations and other facility or route features that are identified for the alternative. Several of the alternatives have multiple route options or different station choices, which could result in differences in the total acquisition estimate; the acquisition for other available choices is also provided, allowing comparison of the differences between the impacts of the components of the alternative.

Table 4.2-1. Summary of Potential Parcel Acquisition Impacts by Segment

	Commercial/ Industrial		Total Comm/Ind BLDG Sq Ft	Public/ Institutional		Residential				Acquisitions by Segment ¹		
	Partial ¹ ,	Full ²		Partial	Full	SF Partial	SF Full	MF Partial	MF Full	Air Rights, Easements, Partial ³ ,	Full	Total
BALLARD												
1.1 – West Side of 15 th	1	7	33,000	0	0	0	0	0	0	12	7	19
1.1(s) – West Side of 15 th (Single Beam)	1	8	37,000	0	0	0	0	0	1	16	9	25
1.2 – Center of 15 th	3	1	-				2		1	12	4	16
BALLARD PREFERRED ALTERNATIVE	1	8	37,000	0	0	0	0	0	1	16	9	25
INTERBAY/MAGNOLIA												
2.1 – West Side of 15 th /Center of Elliott	0	5	76,000	2	0	0	3	0	1	13	9	22
2.1(s) – West Side of 15 th (Single Beam)	0	4	76,000	1	0	0	3	0	1	16	8	24
2.2 – Center of 15 th /West Side of Elliott	1	6	78,000	0	1	0	0	0	0	10	7	17
Interbay Operations Center C-1 (PA)	0	5	266,500	0	0	0	0	0	0	0	5	5
INTERBAY PREFERRED ALTERNATIVE	0	4	78,000	1	0	0	3	0	1	16	8	24
QUEEN ANNE/SEATTLE CENTER/BELLTOWN												
3.1 – Seattle Center/Republican	0	12	70,000	1	0	0	0	0	1	11	13	24
3.2 – Mercer	1	9	63,000	1	0	0	0	0	1	9	10	19
3.3 – Thomas	0	11	54,000	1	0	0	0	0	0	8	11	19
3.5 – Second/Denny	0	3	19,000	1	1	0	0	0	0	4	4	8
QA/SC PREFERRED ALTERNATIVE	0	4	24,486	1	0	0	0	0	0	17	4	21
DOWNTOWN/PIONEER SQUARE												
4.1 – West Side of Second	0	10	207,000	0	1	0	0	0	0	6	11	17
4.2 – East Side of Second with Crossover	1	9	32,000	0	0	0	0	0	1	4	10	14
4.3 – Center of Second	2	12	207,000	0	1	0	0	0	0	4	13	17
4.4 – East Center of Second	1	6	32,000	0	0	0	0	0	1	4	7	11
DOWNTOWN PREFERRED ALTERNATIVE	0	6	207,551	0	1	0	0	0	0	5	7	12
SODO/CHINATOWN ID/PIONEER SQUARE												
5.1 – East Side of Third/Utah	0	4	111,000	6	0	0	0	0	0	29	4	33
5.2 – West Side of Third/Utah	0	6	240,000	3	0	0	0	0	0	23	6	29
5.2(s) West Side of Third/Utah (Single Beam)	0	6	240,000	4	0	0	0	0	0	24	6	30
SODO PREFERRED ALTERNATIVE	0	6	53,100	4	0	0	0	0	0	23	6	29

Table 4.2-1. Summary of Potential Parcel Acquisition Impacts by Segment (continued)

	Commercial/ Industrial		Total Comm/Ind BLDG Sq Ft	Public/ Institutional		Residential				Acquisitions by Segment ¹		
	Partial ¹ ,	Full ²		Partial	Full	SF Partial	SF Full	MF Partial	MF Full	Air Rights, Easements, Partial ³	Full	Total
WEST SEATTLE												
6.1 – West Seattle I	2	11	14,000	0	0	0	3	0	0	18	14	32
6.2 – West Seattle II	2	6	9,000	1	0	0	0	1	1	29	7	36
6.3(s) – West Seattle North Subsegment	1	0	0	0	0	0	0	0	0	2	0	2
6.4 – West Seattle/Andover-Yancy Subsegment	2	0		0	0	0	0	0	0	11	0	11
6.4(s) – No Station	3	2		0	0	0	2	0	0	8	4	12
6.5 – West Seattle/Genesee Subsegment	1	3	1,000	1	0	0	4	0	2	4	9	13
WEST SEATTLE PREFERRED ALTERNATIVE	1	6	15,000	0	0	0	0	0	0	15	6	21
OPERATIONS CENTER												
INTERBAY (PA)	0	5	266,500	0	0	0	0	0	0	0	5	5
SODO	0	6	283,057	0	0	0	0	0	0	0	6	6
OTHER FACILITIES												
Electrical substations and train storage tracks		0-12									0-12	0-12
TOTAL SYSTEMWIDE ACQUISITIONS (ESTIMATED HIGH RANGE) ⁴	10	61	703,454	10	3	0	9	1	6	107	79	186 ⁵
TOTAL PREFERRED ALTERNATIVE: FULL PROJECT ⁴	2	39	681,637	6	1	0	3	0	2	92	45	137 ⁵

¹ Partial acquisition: a portion of the property is acquired which would not substantially interfere with or impair the use of the site, and the unused portion of the site remains viable.

² Full acquisition: the project requires use of the entire parcel, or interferes with the structures, eliminates the viability of the business or residence, or denies access to the site.

³ Air rights, easements, and touchdowns are included with the summary total of partial acquisitions.

⁴ Parcel totals by type are added vertically from the range of counts within each segment.

⁵ Totals are derived by adding horizontally from range count totals.

Table 4.2-2. Breakdown of Parcels Affected by Guideway and Station Alternatives

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Acquisitions by Segment			
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Air Rights, Easement, Touchdowns	Partial	Full	Total
Ballard Segment													
TOTAL	Alternative 1.1 - West Side of 15th	1	7	0	0	0	0	0	0	11	1	7	19
	Guideway/Switch - West side of 15th									1	0	0	1
	Alt. 1.1.1 - West Bridge		1							10	0	1	11
or	Alt. 1.1.2 - Far West Bridge									12	0	0	12
or	Alt. 1.1.1(s) – West single beam Bridge	1								12	1	0	13
	Station - Crown Hill 1 (West)		3								0	3	3
or	Station - Crown Hill 1A (West)		2								0	2	2
	Station - NW 65th 1 (West)		3								0	3	3
or	Station - NW 65th 1A		2								0	2	2
	Station - NW Market 1 (Southwest)	1									1	0	1
or	Station - NW Market 3 (Northwest)		1								0	1	1
TOTAL	Alternative 1.1 (s)	1	8	0	0	0	0	0	1	15	1	9	25
	Alt. 1.1.1 Guideway – West Bridge	1								10	1	0	11
	Station - Crown Hill 1A (West)		2								0	2	2
	Guideway/Switches									5	0	0	5
	Station - NW 65th 1B (West)		3								0	3	3
	Station - NW Market 3A (Northwest)		3						1		0	4	4
TOTAL	Alternative 1.2 - Center of 15th	3	1	0	0	0	2	0	1	9	3	4 (1v)	16
	Alt. 1.2 Guideway – Center of 15 th /East Bridge									9	0	0	9
	Station - Crown Hill 2 (Center)	1					1				1	1	2
	Station - NW 65th 2 (Center)		1 (1v)				1		1		0	3	3
	Station - NW Market 2 (Center)	2									2	0	2

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
TOTAL	Segment 1 Preferred Alternative	1	8	0	0	0	0	0	1	15	1	9	25
	Station - Crown Hill 1A (West)		2								0	2	2
	Guideway/Switches									5	0	0	5
	Station - NW 65th 1B (West)		3								0	3	3
	Station - NW Market 3A (Northwest)		3						1		0	4	4
	Alt. 1.1.1 West Bridge	1								10	1	0	11
Interbay/Magnolia Segment													
TOTAL	Alternative 2.1 - West Side of 15th/Center of Elliott	0	5	2	0	0	3	0	1	11	2	9 (1v)	22
	Alt. 2.1.1 - West Bridge Connection			1						8	1	0	9
or	Alt. 2.1.1(s) – West single beam Bridge			1						9	1	0	10
or	Alt. 2.1.2 - Far West Bridge Connection			1						4	1	0	5
	Station - Dravus 1 (16th)		1								0	1	1
or	Station - Dravus 1A (16th)	1	1								1	1	2
or	Station - Dravus 1B		1 (1v)				2		1		0	4	4
	Alt. 2.1 Guideway (Dravus 1B)						1			3	0	1	4
or	Alt. 2.1 Guideway (Dravus 1 & 1A)		1 (1v)				3		1	3	0	5	8
	Station - Howe 1 (West)		2 (1v)								0	2	2
or	Station - Howe 1A (Blaine)		2								0	2	2
	Alt. 2.1 Guideway (Howe 1A)									4	0	0	4
	Station - Elliott and Mercer 1 (Center)		1	1							1	1	2
or	Station - Elliott and Mercer 1A (Center)		1								0	1	1
TOTAL	Alternative 2.1 (s)	0	4	1	0	0	3	0	1	15	1	8	24
	Alt. 2.1.1 Guideway - West Bridge			1						8	1	0	9
	Alt. 2.1 (s) Guideway/Switch						1			7	0	1	8
	Station - Dravus 1B (Barrett)		1 (1v)				2		1		0	4	4
	Station - Howe 1A (Blaine)		2								0	2	2
	Station - Elliott and Mercer 1A (Center)		1								0	1	1

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
TOTAL	Alternative 2.2 - Center of 15th/ West Side of Elliott	1	6	0	1	0	0	0	0	9	1	7 (1v)	17
	Alt. 2.2.1 Guideway - East Bridge									4	0	0	4
	Alt 2.2 Guideway / Switch									3	0	0	3
	Station - Dravus 2 (15th)		4								0	4	4
	Station - Howe 2 (Center)	1	2 (1v)								1	2	3
or	Station - Prospect 3 (West)		1								0	1	1
	Station - Elliott and Mercer 2 (West)				1					2	0	1	3
TOTAL	Segment 2 Preferred Alternative	0	4	1	0	0	3	0	1	15	1	8 (1v)	24
	Alt. 2.1.1 West Bridge Connection			1						8	1	0	9
	Alt. 2.1 Guideway/Switch						1			7	0	1	8
	Station - Dravus 1B (Barrett)		1 (1v)				2		1		0	4	4
	Station - Howe 1A (Blaine),		2								0	2	2
	Station - Elliott and Mercer 1A (Center)		1								0	1	1
	Interbay Operations Center (C-1) Including Guideway	0	5 (3v)	0	0	0	0	0	0	0	0	5 (3v)	5
Queen Anne/Seattle Center/Belltown Segment													
TOTAL	Alternative 3.1 - Seattle Center/Republican	0	12	1	0	0	0	0	1	10	1	13 (1v)	24
	Alt. 3.1 Guideway/Switch		4						1	10	0	5	15
	Station - Seattle Center/Queen Anne 1, 1A			1							1	0	1
	Station - Seattle Center/Fifth and Broad 1		6 (1v)								0	6	6
or	Station - Seattle Center/Fifth and Broad 1A (Southwest)		3								0	3	3
	Station - Belltown 1 (Center-West)		2								0	2	2
or	Station - Belltown 1A (Center-West)		1								0	1	1
or	Station - Belltown 2 (Center-East)	1									1	0	1
TOTAL	Alternative 3.2 – Mercer	1	9	1	0	0	0	0	1	7	2	10 (1v)	19
	Alt. 3.2 Guideway	1	1						1	7	1	2	10
	Station - Seattle Center/Queen Anne 1, 1A			1							1	0	1
	Station - Seattle Center/Fifth and Broad 2		3 (1v)								0	3	3

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
or	Station - Seattle Center/Fifth and Broad 1A		3								0	3	3
	Alt. 3.2.3 Guideway (Broad 1A)									3	0	0	3
	Station - Belltown 3 (West)		5								0	5	5
or	Station - Belltown 1 (Center-West)		2								0	2	2
or	Station - Belltown 1A (Center-West)		1								0	1	1
TOTAL	Alternative 3.3 - Thomas	0	11	1	0	0	0	0	0	7	1	11	19
	Alt. 3.3 Guideway		3							7	0	3	10
	Station - Seattle Center/Queen Anne 2			1							1	0	1
	Station - Seattle Center/Fifth and Broad 1		6								0	6	6
	Station - Belltown 1 (Center-West)		2								0	2	2
or	Station - Belltown 1A (Center-West)		1								0	1	1
or	Station - Belltown 2 (Center-East)	1									1	0	1
TOTAL	Alternative 3.5 - Second/Denny	0	3	1	1	0	0	0	0	3	1	4	8
	Alt. 3.5 Guideway				1					3	0	1	4
	Station - Seattle Center/Queen Anne 2			1							1	0	1
	Station - Denny 3		1								0	1	1
	Station - Belltown 1 (Center)		2								0	2	2
or	Station - Belltown 1A (Center-West)		1								0	1	1
or	Station - Belltown 2 (Center-East)	1									1	0	1
TOTAL	Segment 3 Preferred Alternative	0	4	1	0	0	0	0	0	16	1	4	21
	Guideway/Switch									16	0	0	16
	Station - Seattle Center/Queen Anne 1A (North)			1							1	0	1
	Station - Seattle Center/Fifth and Broad 1A (Southwest)		3								0	3	3
	Station - Belltown 1A (West)		1								0	1	1

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
Downtown/Pioneer Square Segment													
TOTAL	Alternative 4.1 - West Side of Second	0	10	0	1	0	0	0	0	6	0	11 (1v)	17
	Alt. 4.1 Guideway									6	0	0	6
	Station - Fifth and Stewart 1 (Northwest)		5								0	5	5
or	Station - Fifth and Stewart 1A (West)		1								0	1	1
or	Station - Fifth and Stewart 2 (Virginia)	2	3								2	3	5
or	Station - Fifth and Stewart 2A (Vir.-Center)		2 (1v)								0	2	2
	Station - Pike 1A (West)		4 (1v)								0	4	4
or	Station - Pike 1B (West)		3 (2v)								0	3	3
	Station - Madison 1 (West)				1						0	1	1
	Station - Yesler 1 (West)		1								0	1	1
TOTAL	Alternative 4.2 - East Side of Second with Crossover	1	9	0	0	0	0	0	1	3	1	10 (3v)	14
	Alt. 4.2 Guideway		4 (3v)							3	0	4	7
	Station - Fifth and Stewart 3 (Lenora)		3						1		0	4	4
	Station - Pike 2 (East)		1								0	1	1
	Station - Madison 2 (East)	1									1	0	1
	Station - Yesler 1 (West)		1								0	1	1
TOTAL	Alternative 4.3 - Center of Second	2	12	0	1	0	0	0	0	2	2	13 (3v)	17
	Alt. 4.3 Guideway – Center of Second		4 (2v)							2	0	4	6
	Station - Fifth and Stewart 2 (Virginia)	2	3								2	3	5
	Station - Pike 3 (Center)		4 (1v)								0	4	4
	Station - Madison 3 (Center)				1						0	1	1
	Station - Yesler 2 (Center)		1								0	1	1

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns			
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full		Partial	Full	Total
TOTAL	Alternative - 4.4 East Center of Second	1	6	0	0	0	0	0	1	3	1	7 (1v)	11
	Alt. 4.4 Guideway - East of Center of Second		1 (1v)							3	0	1	4
	Station - Fifth and Stewart 3 (Lenora)		3						1		0	4	4
	Station - Pike 2A (East Center)		1								0	1	1
	Station - Madison 2A (East Center)	1									1	0	1
	Station - Yesler 1 (West)		1								0	1	1
TOTAL	Segment 4 Preferred Alternative	0	6	0	1	0	0	0	0	5	0	7 (3v)	12
	Alternative 4.1 - Guideway									5	0	0	5
	Station - Fifth and Stewart 2A (Virginia Center)		2 (1v)								0	2	2
	Station - Pike 1B (West)		3 (2v)								0	3	3
	Station - Madison 1 (West)				1						0	1	1
	Station - Yesler 1 (West)		1								0	1	1
SODO/Chinatown ID/Pioneer Square Segment													
TOTAL	Alternative 5.1 - East Side of Third/Utah	0	4	6	0	0	0	0	0	23	6	4	33
	Alt. 5.1.1 Guideway - East Side of Third/Utah			1						23	1	0	24
or	Alt. 5.1.2 Guideway - First Avenue South		2	1						22	1	2	25
	Station - Weller/King Street Station 1			4							4	0	4
	Station - Safeco Field 1			1							1	0	1
	Station - Lander 1 (Northeast)		4								0	4	4
or	Station - Lander 2 (Southwest)		2								0	2	2
or	Station - Lander 4 (Utah)		1								0	1	1
TOTAL	Alternative 5.2 - West Side of Third/Utah	0	6	3	0	0	0	0	0	20	3	6 (1v)	29
	Alt. 5.2.2 Guideway - West Side of Third/Utah			1						20	1	0	21
	Station - Weller/King Street 2 (Event)			2							2	0	2
	Station - Lander 3 (Diagonal)		6 (1v)								0	6	6

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Acquisitions by Segment											
		Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
TOTAL	Alternative 5.2 (s)	0	6	4	0	0	0	0	0	20	4	6 (1v)	30
	Alt. 5.2 (s) - Guideway/Switch			1						20	1	0	21
	Station - Weller/King Street Station 2			2							2	0	2
	Station - Safeco Field 1	0		1							1	0	1
	Station - Lander 3		6 (1v)								0	6	6
TOTAL	Segment 5 Preferred Alternative	0	6	4	0	0	0	0	0	19	4	6 (1v)	29
	Guideway			1						19	1	0	20
	Station - Weller/King Street 2 Event			2							2	0	2
	Station/Switch - Safeco Field 1			1							1	0	1
	Station - Lander 3		6 (1v)								0	6	6
	SODO Operations Center (C-2) Including Guideway	0	6	0	0	0	0	0	0	0	0	6	6
West Seattle Segment													
TOTAL	Alternative 6.1 - West Seattle I	2	11	0	0	0	3	0	0	16	2	14 (2v)	32
	Alt. 6.1 Guideway/Switch	1	5 (2v)				3			16	1	8	25
	Alt. 6.1.2 Guideway (Pigeon Point)									1	0	0	1
	Station - Delridge 1 (26th)	1									1	0	1
	Station - Avalon 1 (Center)		3								0	3	3
	Station - Alaska Junction 1 and 1A (42nd/Edmunds)		2								0	2	2
	Station - Morgan Junction 1 and 1A (West Option)		1								0	1	1
TOTAL	Alternative 6.2 - West Seattle II	2	6	1	0	0	0	1	1	25	4	7 (1v)	36
	Guideway to Avalon									16	0	0	16
	Guideway, Avalon to Morgan Junction		2 (1v)						1	9	0	3	12
	Guideway, 6.2.2		3								0	3	3
	Station - Delridge 2 (Andover)	1									1	0	1
	Station - Avalon 2A (35th)			1							1	0	1
or	Station - Avalon 2B (35th) (6.2.2)		1 (1v)								0	1	1

Table 4.2-2. Summary Breakdown of Parcels Affected by Guideway and Station Alternatives (continued)

										Acquisitions by Segment			
Notes	Italics indicate other available station/guideway alternatives. Totals reflect estimate with a representative set of station/route alternatives. Vacant parcels indicated by (v).	Commercial/Industrial		Public/Institutional		Single-Family Residential		Multifamily Residential		Air Rights, Easement, Touchdowns	Partial	Full	Total
		Partial ¹	Full	Partial ¹	Full	Partial ¹	Full	Partial ¹	Full				
	Station - Alaska Junction 2 (44th/California)		3								0	3	3
	Station - Morgan Junction 2 (Center)	1	1					1			2	1	3
TOTAL	Alternative 6.3(s) - West Seattle North Subsegment	1	0	0	0	0	0	0	0	1	1	0	2
	Guideway - West Seattle North Subsegment									1	0	0	1
	Station - Delridge 3 (Nucor)	1									1	0	1
TOTAL	Alternative 6.4 - West Seattle Andover/Yancy Subsegment	2	0	0	0	0	0	0	0	9	2	0	11
	Guideway/Switch - West Seattle Bridge to Yancy	1								9	1	0	10
	Station - Delridge 1A (Delridge/Andover)	1									1	0	1
TOTAL	Alternative 6.4 (s) – no station	3	2	0	0	0	2	0	0	5	3	4 (2v)	12
	Guideway/Switch - Andover/Yancy	3	2 (2v)				2			5	3	4	12
TOTAL	Alternative 6.5 - Genesee Subsegment	1	3	1	0	0	4	0	2	2	2	9	13
	Guideway - Genesee Subsegment	1	3				4		2	2	1	9	12
	Station - Delridge 4 (Genesee)			1							1	0	1
TOTAL	Segment 6 Preferred Alternative	1	6	0	0	0	0	0	0	14	1	6 (2v)	21
	Guideway - Alternative 6.3 (s) (Delridge)									1	0	0	1
	Guideway – Alternative 6.2.2 (Avalon)		2 (1v)							1	0	2	3
	Guideway – Alternative 6.1 (Alaska Junction)									10	0	0	10
	Guideway - Alternative 6.1.6(s) (California)									2	0	0	2
	Station – Delridge 3 (Nucor/Andover)	1									1	0	1
	Station - Avalon 2B (35th)		1 (1v)								0	1	1
	Station - Alaska Junction 1 (42nd/Edmonds)		2								0	2	2
	Station - Morgan Junction 1A		1								0	1	1

¹ Partial acquisition: a portion of the property is acquired which would not substantially interfere with or impair the use of the site, and the unused portion of the site remains viable. This could include some, but not all parking.

² Full acquisition: the project alignment requires use of the entire parcel, or if the project interferes with the structure/s, eliminates the viability of the business or residence, or denies access to the site.

Table 4.2-3. Business and Household Displacement Impacts by Segment

		Employers	Households
Ballard Segment			
TOTAL	Alternative 1.1 - West Side of 15th	8-15	0
Guideway	West Side 15 th		
Guideway	Alt. 1.1.1 West Bridge Option	1	
Guideway	Alt. 1.1.2 Far West Bridge Option		
Station	Crown Hill 1 (West, 85 th)	7	
Station	Crown Hill 1A (West)	4	
Station	NW 65 th 1 (West) & 1B	6	
Station	NW 65 th 1A	4	
Station	NW Market 1 (Southwest)		
Station	NW Market 3 (Northwest)	1	
TOTAL	Alternative 1.1 (s)	13	6
Guideway	Single Beam configuration		
Station	Crown Hill 1A (West)	4	
Station	NW 65 th 1B (West)	6	
Station	NW Market 3A (Northwest)	3	6
TOTAL	Alternative 1.2 - Center of 15th	0	4
Guideway	Center of 15 th Option		
Guideway	Center of 15 th /East Bridge Option		
Station	Crown Hill 2 (Center)		1
Station	NW 65 th 2 (Center)		3
Station	NW Market 2 (Center)		
Ballard Preferred Alternative		13	6
Guideway	West Side of 15 th		
Guideway	Alt. 1.1.1 West Bridge		
Station	Crown Hill 1A (West)	4	
Station	NW 65 th 1B (West)	6	
Station	NW Market 3A	3	6
Interbay/Magnolia Segment			
TOTAL	Alternative 2.1 - West Side of 15th/Center of Elliott	2-5	7
Guideway	West Side of 15 th /Center of Elliott		7
Guideway	Alt. 2.1.1 West Bridge Connection	1	
Guideway	Alt. 2.1.2 Far West Bridge Connection		
Station	Dravus 1 (16 th)	1	
Station	Dravus 1A (16 th)	1	
Station	Dravus 1B		6
Station	Howe 1 (West)	1	

Table 4.2-3. Business and Household Displacement Impacts by Segment(continued)

		Employers	Households
Station	Howe 1A (Blaine)	2	
Station	Elliott and Mercer 1 (Center)	1	
Station	Elliott and Mercer 1A (Center)	1	
TOTAL	Alternative 2.1 (s)	4	7
Guideway	Single Beam configuration	1	1
Station	Dravus 1B (Barrett)		6
Station	Howe 1A (Blaine)	2	
Station	Elliott and Mercer 1A (Center)	1	
TOTAL	Alternative 2.2 - Center of 15th/West Side of Elliott	7	0
Guideway	Elliott East Bridge Option		
Station	Dravus 2 (15 th)	5	
Station	Howe 2 (Center)	1	
Station	Prospect 3 (West)	1	
Station	Elliott and Mercer 2 (West)		
	Interbay Preferred Alternative	4	7
Guideway	West Side of 15 th /Center of Elliott		1
Guideway	Alt. 2.1.1 West Bridge Connection	1	
Station	Dravus 1B (Barrett ^h)		6
Station	Howe 1A (Blaine) <<Future>>	2	
Station	Elliott and Mercer 1A (Center)	1	
C-1 Operations Center – PA		1	0
Queen Anne/Seattle Center/Belltown Segment			
TOTAL	Alternative 3.1 - Seattle Center/Republican	3-11	29
Guideway	Seattle Center/Republican		
Guideway	Harrison Residence		29
Guideway	Seattle Center/NW Route (w/Broad 1)	4	
Station	Seattle Center/Queen Anne 1 (North)		
Station	Seattle Center/Queen Anne 1A (North)		
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	
Station	Seattle Center/Fifth and Broad 1A (Southwest)	3	
Station	Belltown 1 (Center-West)	3	
Station	Belltown 1A (West)	1	
Station	Belltown 2 (Center-East)		
TOTAL	Alternative 3.2 – Mercer	4-12	29
Guideway	Harrison		29
Guideway	Mercer – Fifth	0-3	
Station	Seattle Center/Queen Anne 1, 1A (North)		
Station	Seattle Center/Fifth and Broad 1A (Southwest)	3	
Station	Seattle Center/Fifth and Broad 2 (Harrison)	3	

Table 4.2-3. Business and Household Displacement Impacts by Segment(continued)

		Employers	Households
Station	<i>Belltown 1 (Center – West)</i>	3	
Station	<i>Belltown 1A (West)</i>	1	
Station	<i>Belltown 3 (West)</i>	6	
TOTAL	Alternative 3.3 – Thomas	11-14	0
Guideway	Thomas	4	
Station	Seattle Center/Queen Anne 2 (South)	3	
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	
Station	Belltown 1 (Center-West)	3	
Station	<i>Belltown 1A (West)</i>	1	
Station	<i>Belltown 2 (Center-East)</i>		
TOTAL	Alternative 3.5 - Second/Denny	14-17	0
Guideway	Second/Denny	10	
Station	Seattle Center/Queen Anne 2 (South)	3	
Station	Denny 3	1	
Station	Belltown 1 (Center-West)	3	
Station	<i>Belltown 1A (West)</i>	1	
Station	<i>Belltown 2 (Center-East)</i>		
	QA/SC Preferred Alternative	4	0
Guideway	Seattle Center/Republican		
Guideway	Alt. 3.1 Northwest route		
Station	Seattle Center/Queen Anne 1A (North)		
Station	Seattle Center/Fifth and Broad 1A (Southwest)	3	
Station	Belltown 1A (West)	1	
Downtown/Pioneer Square Segment			
TOTAL	Alternative 4.1 - West Side of Second	8-21	0
Station	Fifth and Stewart 1 (Northwest)	9	
Station	<i>Fifth and Stewart 1A (West)</i>	1	
Station	<i>Fifth and Stewart 2 (Virginia)</i>	2	
Station	<i>Fifth and Stewart 2A (Virginia Center)</i>	1	
Station	Pike 1A (West)	10	
Station	<i>Pike 1B (West)</i>	5	
Station	Madison 1 (West)	1	
Station	Yesler 1 (West)	1	
TOTAL	Alternative 4.2 - East Side of Second with Crossover	10	56
Guideway	East Side of Second with Crossover	2	
Station	Fifth and Stewart 3 (Lenora)	3	56
Station	Pike 2 (East)	1	
Station	Madison 2 (East)	3	
Station	Yesler 1 (West)	1	

Table 4.2-3. Business and Household Displacement Impacts by Segment(continued)

		Employers	Households
TOTAL	Alternative 4.3 – Center of Second	21	0
Guideway	Center of Second	7	
Station	Fifth and Stewart 2 (Virginia)	2	
Station	Pike 3 (Center)	10	
Station	Madison 3 (Center)	1	
Station	Yesler 2 (Center)	1	
TOTAL	Alternative 4.4 - East of Center of Second	9	56
Guideway	East of Center of Second	1	
Station	Fifth and Stewart 3 (Lenora)	3	56
Station	Pike 2A (East Center)	1	
Station	Madison 2A (East Center)	3	
Station	Yesler 1 (West)	1	
	Downtown Preferred Alternative	8	0
Guideway	Alt. 4.1		
Station	Fifth and Stewart 2A (Virginia Center)	1	
Station	Pike 1B (West)	5	
Station	Madison 1 (West)	1	
Station	Yesler 1 (West)	1	
SODO/Chinatown ID/Pioneer Square Segment			
TOTAL	Alternative 5.1 - East Side of Third/Utah	1-4	0
Guideway	East Side of Third/Utah		
Guideway	Alt. 5.1.2 First Avenue S	2	
Station	Lander 2 (Southwest)	1	
Station	Weller/King Street 1 (Standard)		
Station	Safeco Field 1		
Station	Lander 1 (Northeast)	4	
Station	Lander 4 (Utah)	1	
TOTAL	Alternative 5.2 - West Side of Third/Utah	5	0
Guideway	West Side of Third/Utah		
Station	Weller/King Street 2 (Event)		
Station	Lander 3 (Diagonal)	5	
TOTAL	Alternative 5.2 (s)	5	0
Guideway	Single Beam configuration		
Station	Weller/King Street Station 2		
Station	Safeco Field 1		
Station	Lander 3	5	

Table 4.2-3. Business and Household Displacement Impacts by Segment(continued)

		Employers	Households
C-2 Operations Center		5	0
	SODO Preferred Alternative	5	0
Guideway	West Side of Third/Utah/5.2(s)		
Station	Weller/King Street 2 (Event)		
Station	Safeco Field 1 with switch		
Station	Lander 3	5	
West Seattle Segment			
TOTAL	Alternative 6.1 - West Seattle I	11	5
Avalon Guideway and Station 1	Delridge: West Seattle Bridge to Avalon (Delridge 1)	5	5
	Avalon 1 (Center) and Avalon Guideway	3	
	Alaska Junction 1 (42 nd /Edmunds) and Guideway	1	
	Alaska Junction 1A (42 nd /Edmunds) and Guideway	1	
	Morgan Junction 1 (West) and Guideway	2	
	Morgan Junction 1A (West) and Guideway	2	
TOTAL	Alternative 6.2 – West Seattle II	3-4	0-3
	New Bridge to Delridge 2		
	Avalon 2A (35 th) and 6.2.1 Alignment	1	3
	<i>Avalon 2B (35th) and 6.2.2 Alignment</i>	2	
	Alaska Junction 2 (44 th /California) and Guideway		
	Morgan Junction 2 (Center) and Guideway	2	
TOTAL	Alternative 6.3(s) - Delridge North Subsegment	0	0
	Delridge North Guideway and Delridge 3 Station		
TOTAL	Alternative 6.4 - West Seattle Andover/Yancy Subsegment	0	2
	Delridge 1A (Delridge/Andover) and Guideway		2
	Alternative 6.4(s) – with no station	0	2
	Andover/Yancy Guideway		2
TOTAL	Alternative 6.5 - Genesee Subsegment	5	8
	Guideway and Delridge 4	5	8
	West Seattle Preferred Alternative	4	0
	Delridge Guideway and Station		
	Avalon Guideway and Station	1	
	Alaska Guideway and Alaska Junction 1 (42 nd /Edmonds)	1	
	Morgan Junction 1A	2	

4.2.2.2 Segment 1: Ballard Segment

As Table 4.2-1 shows, the Preferred Alternative would affect an estimated 25 properties in the Ballard Segment of the Green Line, with nine properties fully acquired and up to 16 partially acquired, including air rights, easements, or the location of columns or other supports. Alternative 1.1 (West Side of 15th) is estimated to require full acquisition of seven commercial/industrial properties. Most of the businesses potentially affected by this alternative are in station locations, and include retail, commercial, and fast food establishments. Alternative 1.2 (Center of 15th) would affect 16 properties, including four full parcel acquisitions. Business displacement and relocation effects for the entire alternative range from up to 15 businesses for Alternative 1.1, to fourteen businesses for Alternatives 1.1(s) and 13 for the Preferred Alternative. Alternative 1.2 would not require business displacements. Residential displacements for Alternative 1.1(s) and the Preferred Alternative are all related to Market 3A, which could displace a six-unit apartment building. Alternative 1.2 would displace two single-family residences and one duplex for the Crown Hill 2 and NW 65th 2 stations.

Alignment

The acquisition effects of the alternatives primarily occur in station areas and along the approaches to the new bridge. The alignment, including guideway supports can largely be accommodated within available public rights-of-way. In addition to bridge related impacts stated below, the alignment for Alternative 1.1 (West Side of 15th) would involve one property, requiring air rights or easement for a switch south of the NW Market Street station. The alignment of Alternative 1.2 (Center of 15th) would not require property outside of station areas or the bridge. The Preferred Alternative would involve five properties for switches north of the NW Market station, north and south of the NW 65th Street station, and approaching the Crown Hill station at NW 85th Street.

The Ballard Crossing alternatives are included within the total estimates for the Ballard alternatives. For purposes of comparison, the northern bridge approach to the Ship Canal for Alternative 1.1.1 (Preferred Alternative) and 1.1.1(s) would require air rights, column or structural touchdown acquisition easements for 11 to 13 properties. Alternative 1.1.1 (Preferred Alternative) assumes the full acquisition of a property with a commercial business, while Alternative 1.1.1(s) assumes that the business could remain in operation with a partial acquisition of the property. Alternative 1.1.2 (Far West Bridge) would affect 12 properties with air rights or easements, but is not assumed to require their full or partial acquisition. Alternative 1.2's eastern bridge route would affect nine properties with air rights or easements, with no full or partial acquisitions required.

Stations

A total of three commercial/industrial properties could be acquired for the Crown Hill 1 (West, 85th) station (Alternative 1.1). Crown Hill 1A, involving a smaller station design, would acquire two properties. The Crown Hill 2 (Center) station (Alternative 1.2) could partly acquire one commercial property and fully acquire one single-family residential parcel.

The NW 65th 1 (West) and 1B station options could require full and/or partial acquisition of three commercial properties, while the NW 65th 1A option would reduce the acquisitions to two full properties. The NW 65th 2 (Center) station could require full acquisition of three properties. Of these properties, one is a single-family residence, one is a two-unit residential property, and the third is a vacant parcel.

The NW Market station alternatives could require full acquisition of one to four properties. The NW Market 1 (Southwest) station (an option under Alternative 1.1) could require partial acquisition of one commercial property. The station would occupy a portion of the existing parking area of a

drugstore/pharmacy. Some parking would remain, and SMP believes business would remain viable despite the parking loss, given the potential for replacement parking and the additional foot traffic that would be attracted to the station. However, there is the potential that the property could be determined to be a full acquisition and the business displaced. The NW Market 2 (Center) station (Alternative 1.2) could require partial acquisition of two commercial properties. The NW Market 3 (Northwest) station (an option under Alternative 1.1) could require full acquisition of one commercial property, a restaurant. An additional option (Market 3A) would increase the acquisitions in this location to a total of four parcels to allow construction staging to be consolidated within the station construction area. This would involve the displacement of the restaurant as discussed for Market 3, as well as a 6-unit apartment building, a parking lot, and a commercial parcel.

Ballard Segment Preferred Alternative

The Preferred Alternative would affect 25 properties, including full acquisition of nine properties and a partial acquisition of one property. Fifteen properties would be affected by air rights, easements or touchdowns. The full acquisitions are in station areas and include eight commercial properties and one 6-unit residential property. A total of 13 businesses and six households would be displaced. The businesses include four businesses at the Crown Hill 1A station, six businesses at the NW 65th 1B (West) station, and three businesses at the Market 3A (Northwest) station.

4.2.2.3 Segment 2: Interbay/Magnolia Segment

In this segment, Alternative 2.1 (West Side of 15th/Center of Elliott) could affect an estimated 22 properties, Alternative 2.1(s) would affect 24, and Alternative 2.2 (Center of 15th) would affect 17. The Preferred Alternative would affect 24. All three of the Interbay alignment alternatives would require an additional five property acquisitions if the Interbay Operations Center (C-1) is selected, including two parcels for the Operations Center and three parcels for guideways to the Operations Center.

For Alternative 2.1, nine properties could require full acquisition and up to two could require partial acquisition. Of the properties to be fully acquired, five are commercial or industrial, three are single-family residences, and one is multifamily residential. Up to nine properties could require partial acquisition, air rights or easements for the guideway, columns, and bents, including property owned by the Port of Seattle. This includes the west bridge and far west bridge connections (Alternatives 2.1.1 and 2.1.2), which are described in more detail below. Alternative 2.1(s) involves similar acquisitions and related effects to Alternative 2.1, with the difference between the single beam and dual beam alternatives being in the station alternative assumed.

Alternative 2.2 (Center of 15th/West Side of Elliott) could affect up to 17 properties, with up to seven fully acquired, all commercial/industrial or public/institutional parcels.

The 24 properties affected by the Preferred Alternative include eight properties fully acquired, one partial acquisition, and 15 properties requiring air rights or easements. Four of the properties requiring full acquisition are commercial or industrial, and four are residential.

The business and residential displacement and relocation effects of the Interbay alternatives would include up to five businesses and six residences displaced by Alternative 2.1. Alternative 2.1(s) would displace four businesses and seven residences, Alternative 2.2 would displace seven businesses, and the Preferred Alternative would displace four businesses and seven residences.

Alignment

The guideway alignment of Alternative 2.1 would affect an estimated eight properties. This includes three single-family residences, one multifamily residence with four units, and one vacant parcel south of W Dravus Street that the guideway would cross to align with 15th Avenue W. These parcels could also be used for the Dravus 1B (Barrett) station, as noted in the station discussion. The guideway for the West Bridge connection (Alternative 2.1.1) would require a partial acquisition or easement of Port of Seattle property, and the guideway for the Far West Bridge connection (Option 2.1.2) would not require full acquisitions.

On the land side, properties affected by partial acquisitions for Alternative 2.1 include portions of Port of Seattle's Fishermen's Terminal used for commercial and marine industrial activities. The extent of area to be acquired is based on assumptions for the location of piers, and will be refined when the alignment alternative and bridge type are selected. However, Alternative 2.1 (with West Bridge connection 2.1.1) would potentially involve the use of areas currently occupied by a marine railway and adjacent to a boat haul out operation/boat maintenance center, which could be displaced. The far west connection (Alternative 2.1.2) would cross over and potentially use portions of other leased properties near Fishermen's Terminal, which include a variety of commercial, industrial, and retail uses, including moorage areas.

The Center of 15th/West of Elliott (Alternative 2.2) guideway alternatives also avoids full property acquisitions through the Interbay Segment, although it requires partial acquisition of four properties in the northern portion of the Interbay Segment for air rights and touchdown points. For all alternatives, the use of aquatic lands (Washington State Department of Natural Resources lease) would also be required to locate bridge piers. With Alternative 2.2's East Bridge connection, the Port of Seattle properties affected by the West and Far West Bridge connections would be avoided and the partial acquisitions would instead involve areas of the privately owned Salmon Bay Terminals.

Stations

Development of the Dravus 1 (16th) station (Alternative 2.1) could require acquisition of one commercial property, a QFC supermarket. Dravus 1A would modify the siting plan to avoid a full acquisition of the supermarket, with a partial acquisition of the parking area of the QFC and a full acquisition of a restaurant on an adjacent lot. Dravus 1B would site the station one block to the south, utilizing four properties that would otherwise be displaced by the guideway as it moves southeast toward 15th Avenue W, including two single family residential properties, a fourplex and a vacant parcel. Alternative 2.2's Dravus 2 (15th) station would acquire four commercial properties along 15th Avenue W, including a convenience store and four small businesses.

Two properties could be acquired for the Howe 1 (West) station (Alternative 2.1). Two businesses on one parcel would be displaced and the other parcel is vacant. Developing Howe 2 (Center) could require full acquisition of the same two properties as Howe 1, plus an additional partial acquisition of a commercial property with a self-storage business. At Howe 1A (Blaine), two commercial properties would be fully acquired, and the station would also require switches that would involve partial acquisition that would affect an additional four properties.

The Elliott and Mercer Station 1 (Center) could require full acquisition of one commercial property (a restaurant) and partial acquisition of one parcel owned by King County Metro. Station 1A would involve the acquisition of the property with the restaurant only. Elliott and Mercer Station 2 (West) could require full acquisition of the parcel owned by King County Metro, and would partly acquire air rights or easements for three parcels including one owned by the City of Seattle.

If the Operations Center is constructed at the Interbay site, two parcels owned by the Northwest Center (formerly known as The Northwest Center for the Retarded) could be acquired. These parcels are currently used by up to eight enterprise operations managed by the Northwest Center.

Interbay Preferred Alternative

The Interbay Preferred Alternative would affect 24 properties, including eight full acquisitions, one partial acquisition, and air rights or easements of an additional 15 properties. The impacts are similar to those discussed for Alternative 2.1. The west bridge connection for the Preferred Alternative would involve the use of areas currently occupied by a marine railway and adjacent to a dry dock operation/boat maintenance center, which could be displaced. The use of Dravus Station 1B(Barrett) would avoid the acquisition of the QFC supermarket property, and instead utilize properties that would otherwise be acquired for the guideway. The Preferred Alternative also features a future Howe 1A (Blaine) station that would eventually require two full commercial property acquisitions.

The total of acquisitions for the Preferred Alternative also includes the Operations Center at the Interbay Site, involving the acquisition of the two parcels owned by the Northwest Center, as discussed above. The guideway to the Operations Center would require acquisition of three smaller parcels.

4.2.2.4 Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Queen Anne/Seattle Center/Belltown Segment of the Green Line could affect between up to 24 properties depending on the alignment and station alternatives selected. All of the alternatives would require the use of part of at least one and up to six parcels within the Seattle Center. The impacts of the Green Line on Seattle Center operations are discussed in more detail in Section 4.3, Land Use and Neighborhoods, but the acquisition or easement needs of the alternatives are identified below.

Alternative 3.1 (Seattle Center/Republican) could affect an estimated 24 properties. Of this total, 13 properties could require full acquisition; and 11 could require partial acquisition, air rights or easements, including City-owned property within the Seattle Center. Buildings or attractions within the Seattle Center could also be displaced. Of the properties identified for full acquisition, all but one are commercial/industrial, and one is an apartment building with 29 units.

Alternative 3.2 (Mercer) could affect 15 to 22 properties with 6 to 10 full acquisitions. Of the 10 full acquisitions, 9 are commercial properties and one is an apartment building with 29 units. One of the partial acquisitions would involve City-owned property within the Seattle Center and includes the displacement of buildings in Seattle Center.

Alternative 3.3 (Thomas) could affect 18 to 19 parcels. Of this total, 9 to 11 were identified as full acquisitions and 8 to 9 as partial acquisitions and air rights or easements. Of the parcels anticipated to be fully acquired, all are commercial properties. Several of the properties to be partially acquired are publicly owned portions of the Seattle Center, and include the displacement of buildings near Key Arena.

Alternative 3.5 (Second/Denny) could affect an estimated eight properties. Of this number, four could be fully acquired and one could be partially acquired. A Key Arena area facility, a Seattle Center office building, and a building owned by Pacific Science Center would be affected.

The Preferred Alternative would affect 21 properties, including four full acquisitions and one partial acquisition. The alternative would require partial acquisition, air rights or easements, including City-owned property within the Seattle Center. Buildings or attractions within the Seattle Center could also be displaced. All of the full acquisitions involve commercial properties.

The business and residential displacement and relocation effects of the alternatives range from a high of 17 businesses for Alternative 3.5 (Denny), and between four and 14 for the other alternatives. A potential acquisition of an apartment building could involve displacement of up to 29 households for Alternatives 3.1 and 3.2. Additional details related to these displacements are provided in the discussions below.

Comparisons of Segment 3 Effects by Area

In response to comments, the property acquisition needs and the related displacement and relocation effects of the alternatives are described below by area within the Queen Anne/Seattle Center/Belltown segment, including W Harrison Street between Elliott Avenue W and First Avenue N, at the Seattle Center to Fifth Avenue N and Denny Way, and along Fifth Avenue in Belltown.

W Harrison Street Subsegment. Acquisitions in this area are limited to the transitions to and from W Harrison Street. For the segment along W Harrison Street, all of the alternatives would involve partial acquisition, air rights or easements for one to two properties to turn from Elliott Avenue W to W Harrison Street. Turning north or south from W Harrison Street at First Avenue N, approaching the Seattle Center, Alternatives 3.1 (Seattle Center/Republican) and 3.2 (Mercer) guideways would pass over an apartment building and parking lot to reach the Seattle Center/Queen Anne 1 or 1A (Northwest) station. The analysis assumes full acquisition of the parking lot and the residential property and displacement/relocation of the residents, although a partial acquisition is also possible and the residential or other use of the building could continue. The Preferred Alternative, which follows this same route to the Seattle Center Queen Anne 1A - Northwest station, identifies the apartment building property for air rights, as well as the adjacent parking lot. Demolition of the apartment building is not required in any case. Alternatives 3.3 (Thomas) and 3.5 (Denny), which turn southwest at First Avenue N, would not involve full or partial acquisitions in the W Harrison Street area, but would cross over an existing parking lot.

Seattle Center. Recognizing the unique nature of the Seattle Center, SMP has involved the City of Seattle, Seattle Center stakeholders and the public about alignment and station alternatives and potential impacts and mitigation, as well as how guideway and station design and function could be used to enhance existing activities at the Center. More discussion of impacts and other aspects of the Green Line alternatives in relationship to the Seattle Center are discussed in Section 4.3, Land Use and Neighborhoods.

For Alternatives 3.1 and 3.2, development of the Seattle Center/Queen Anne 1 or 1A (North) station would involve partial acquisition of an area northwest of Key Arena, within the Art Pavilion parcel owned by the City of Seattle. The use of the property for a station would require removal of several of the Northwest Rooms (rooms to be removed include Shaw, Fidalgo, Lopez, and Orcas), as well as affecting an underground area that serves Key Arena operational functions.

For Alternative 3.1, the guideway along the path of Republican Street through the Seattle Center would require partial acquisition of parcels owned by the City of Seattle and Seattle Public Schools. This includes open areas and pathways within the Seattle Center campus near International Fountain, a portion of the backstage and plant nursery area at Memorial Stadium (owned by Seattle Public Schools), areas of the Fun Forest at Seattle Center House, and areas featuring the existing Seattle Center Monorail station and guideway. However, no major venues or performance spaces would be displaced. Alternative 3.1 could include the potential displacement or relocation of up to two Fun Forest attractions, and the removal of the existing Seattle Center monorail station and the existing monorail leading up to EMP. SMP and Seattle Center staff are discussing Seattle Center property issues, and will continue to discuss appropriate mitigation or compensation.

The guideway for Alternative 3.2 (Mercer) after leaving the Seattle Center Queen Anne 1 or 1A (Northwest) station would be largely outside of the Seattle Center. The route could require air rights or easements at properties including parcels housing Bagley Wright Theatre, KCTS 9 and a Sonics Practice Building and Garage. Alternative 3.3 (Thomas) and Alternative 3.5 (Denny) would require an area southwest of Key Arena for the development of the Seattle Center/Queen Anne 2 (South) station. This could require partial acquisition of a different area of the same parcel, requiring demolition of a building housing the Key Arena ticket office, the Sonics/Storm Team Store and an upstairs office area, affecting three business operations. The guideways departing the station for either Alternative 3.3 or 3.5 could also affect aboveground food storage and handling operational areas related to Key Arena. Column locations or other structural foundation location needs that may affect the Key Arena's south service/loading entrance area, including reserved parking.

As the Alternative 3.3 (Thomas) guideway continues east through Seattle Center, air rights or easements would also be required along the Thomas Street pathway, involving City owned parcels at the Pacific Science Center, Fisher Pavilion, Seattle Children's Theatre, and Seattle Center House, where nearby areas of the Fun Forest could also be affected.

The Alternative 3.5 (Second/Denny) guideway departing the Seattle Center/Queen Anne station would also include removal of the Spruce Building (a multi-story office building within Seattle Center), displacing 10 businesses or non-profit enterprises, including Northwest Folklife's administrative offices. The guideway transitioning from Second Avenue N to Denny Way would require the acquisition of the Frol Building, a multi-story parking structure owned by the Pacific Science Center.

As Alternative 3.1 leaves the Seattle Center campus and approaches the Fifth and Broad station area, a station and alignment refinement would reduce full property acquisitions by up to six parcels, compared to the Fifth and Broad 1 station and related guideway originally evaluated in the DEIS. The original route crossing to the east of Fifth Avenue N with the Seattle Center/Fifth and Broad 1 (Southeast) station could require acquisition of a total of 9 commercial properties. A Fifth and Broad 1A station and a related realignment of the guideway over Fifth Avenue N would reduce the full acquisitions to three commercial properties, and involve partial acquisitions for the guideways and potential storage tracks for the station.

Alternative 3.2 (Mercer) has also been modified for the portion along Fifth Avenue N. the original route with the Seattle Center/Fifth and Broad 2 (Harrison) station and related guideway could require acquisition of three commercial properties, and air rights or easements for an additional three properties along the east side of Fifth Avenue N. For Alternative 3.2.3, which splits the guideways to be on the east and west sides of Fifth Avenue N approaching the Fifth and Broad 1A station, three acquisitions would be involved for the station, and air rights or easements to nine properties could be needed for the guideways.

The Denny 3 (Alternative 3.5) station alternative could require acquisition of one commercial property, a bank branch.

Belltown. None of the alternatives would involve off-street property for the guideway portions of the alignment along Fifth Avenue in Belltown; all property needs are related to the station. The Belltown station could require acquisition of one to five commercial properties, depending upon the alternative selected and the size of the affected parcels. Belltown 1 (Center-West) could require acquisition of two parcels, housing three businesses including the Seattle Glassblowing Studio. Belltown 1A would minimize the station footprint, reducing the acquisition to one parcel with one business, and avoiding the acquisition of the studio. Belltown 2 (Center-East) could require one property (a surface parking lot), and Belltown 3 (West) could acquire five properties, displacing six businesses, including the Seattle Glassblowing Studio.

Preferred Alternative

The Preferred Alternative for the Queen Anne/Seattle Center/Belltown Segment would affect 21 properties, including four full acquisitions, one partial acquisition, and air rights, easements or touchdowns for 16 properties. This represents the lower range of acquisitions for alternatives in the segment, primarily through the use of station and alignment modifications developed for Fifth Avenue N and Broad Street and the revised station in Belltown that were developed to minimize property acquisition needs. The Seattle Center 1A (North) station could involve partial acquisition of a Seattle Center parcel owned by the City of Seattle and would require removal of several of the Northwest Rooms near Key Arena, as well as affecting an underground area that serves Key Arena operational functions. The property needs for the guideway segment within the Seattle Center is the same as described for Alternative 3.1, involving partial acquisition of parcels owned by the City of Seattle and Seattle Public Schools. This includes open areas and pathways within the Seattle Center campus near International Fountain, a portion of the backstage and plant nursery area at Memorial Stadium (owned by Seattle Public Schools), areas of the Fun Forest at Seattle Center House, and areas featuring the existing Seattle Center Monorail station and guideway. However, no major venues or performance spaces would be displaced. There would be potential displacement or relocation of up to two Fun Forest attractions, and the removal of the existing Seattle Center monorail station and the existing monorail leading up to EMP. The Fifth and Broad 1A station option would acquire three commercial properties, and the Belltown 1A (West) station would acquire one commercial property. A total of four businesses would be displaced.

4.2.2.5 Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment could affect up to 17 properties, depending upon the alternative chosen. Several of the displaced properties are parking lots or parking structures, although several commercial and publicly owned properties with buildings could also be acquired.

Alternative 4.1 (West Side of Second) could affect 17 properties, 11 of which could be fully acquired. All but one of the full acquisitions are commercial properties; the one publicly-owned parcel that could be acquired is owned by the Federal Reserve Bank of San Francisco. Most of the full acquisitions are for stations. The acquisitions could displace 8 to 21 businesses.

Alternative 4.2 (East Side of Second with Crossover) could affect 14 properties: 10 could be fully acquired and one could be partially acquired. Of the 10 full acquisitions, nine are commercial properties and one is a multifamily residential building with 56 units. As with Alternative 4.1, most acquisitions are related to stations. The acquisitions could displace 10 businesses, including seven properties currently used for parking.

Alternative 4.3 (Center of Second) could affect up to 17 parcels. Of this total, 13 could be full acquisitions and two could be partial acquisitions. Of the parcels to be fully acquired, 12 are commercial properties and one is the Federal Reserve Bank of San Francisco. An estimated 21 businesses could be displaced. Alternative 4.3 would acquire three parking garages (the Avis Parking Garage, Bon Garage, and the Sinking Ship), and four other properties used for parking.

Alternative 4.4 (East Center of Second) would affect 11 properties, involving full acquisitions of seven parcels and one partial acquisition. Although the alternative involves many of the same station locations as Alternative 4.3, it comparatively reduces the overall acquisitions because it features several station options with lower site acquisition needs.

The Preferred Alternative for the Downtown Segment would involve 12 acquisitions, including seven full property acquisitions and five properties affected by air rights, easements or touchdown requirements.

All but one of the properties to be acquired are commercial properties; the one federally-owned parcel that could be acquired is owned by the Federal Reserve Bank of San Francisco.

Stations

The Fifth and Stewart station alternatives could require full or partial acquisition of either one to or five properties depending on the alternative selected. The Fifth and Stewart 1 (Northwest) station could require full acquisition of five commercial/industrial properties, while station 1A would acquire one commercial property and avoid several acquisitions including the Centennial Building. The Fifth and Stewart 2 (Virginia) station could affect five commercial properties, including a portion of two commercial properties and all of three commercial properties. Fifth and Stewart 2A would reduce these acquisitions to two properties. The Fifth and Stewart 3 (Lenora) station (Alternative 4.2 and 4.4) could require acquisition of four properties: three commercial properties and one multifamily residential property with 56 units.

The Pike station alternatives could require acquisition of one to four commercial properties depending on the alternative selected. Pike 1 (West) A would acquire four, while Pike 1 (West) B would acquire three, including a surface parking lot that would allow a station entrance on First Avenue. Pike 2 and 2A (East) could result in acquisition of one property, and Pike 3 (Center) could require four properties.

Construction of either the Madison 1 (West) or Madison 3 (Center) station alternatives would require acquisition of the Federal Reserve Bank building, located on the west side of Second Avenue. Madison 2 and 2A (East) would occupy the plaza of a commercial office tower. Construction of the Yesler station would require acquisition of the Sinking Ship parking garage situated on the west side of Second Avenue, which is across Second Avenue from the historic Smith Tower.

Downtown Preferred Alternative

The Preferred Alternative for the Downtown Segment would involve 12 acquisitions, including seven full property acquisitions and five properties affected by air rights, easements or touchdown requirements. All but one of the properties to be acquired are commercial properties; the one federally-owned parcel that could be acquired is owned by the Federal Reserve Bank of San Francisco. All of the full acquisitions are for stations. The Preferred Alternative features Fifth and Stewart 2A (Virginia) station, which would require two commercial properties, Pike 1B (West) involving three commercial properties including two parking lots; Madison 1 (West) involving the Federal Reserve Bank building, and Yesler 1 (West), involving the triangular parcel currently housing the Sinking Ship parking garage. A total of eight businesses would be displaced.

4.2.2.6 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Alternatives in the SODO Segment could affect up to 33 properties. Alternative 5.1 (East Side of Third/Utah) could affect 33 properties, including four full acquisitions. Six properties, including public/institutionally owned properties could be partially acquired, as well as 23 properties requiring easements or air rights for the overhead guideway. The properties include parcels owned by the State of Washington, the Washington State Department of Transportation, King County, Port of Seattle, the Stadium Authorities, BNSF and Seattle Public Schools.

Alternative 5.2 (West Side of Third/Utah) could require 29 acquisitions, six of which are full acquisitions of commercial/industrial property. Partially acquired properties include three public properties. Additionally, up to twenty properties could be acquired for the guideways, columns, and bents, including

two publicly owned Seattle Public Schools properties. One of these properties could optionally be fully acquired for use as a train storage facility.

There would be no residential displacements in this segment, and from one to five businesses would be displaced. The SODO Operations Center (C-2) alternative would displace five businesses, although depending on the alignment and station choices along Utah Avenue S, some of these businesses could actually be displaced for the guideway and station.

Stations

The Weller/King Street 1 (Standard) or 2 (Event) stations could require partial acquisition and/or air rights easement of up to four public/institutional properties; no businesses would be affected. Weller/King Street 2, which involves a location to the south of the Weller/King Street 1 station, would involve two partial acquisitions. The Safeco Field 1 station required for the Downtown Turnback could require partial acquisition of a property owned by the Washington State Department of Transportation.

Construction of the Lander 1 (Northeast) station for Alternative 5.1 would require acquisition of three commercial parcels with three retail businesses. The Lander 1 station would displace 27,000 square feet of commercial space. Construction of the Lander 4 (Utah) station would require acquisition of one parcel that houses the Home Depot retail store, which would also be part of the properties needed for a SODO Operations Center alternative. Acquiring Home Depot would displace 107,930 square feet of commercial/warehouse space. Construction of the Lander 2 (Southwest) station for Alternative 5.1.2 would require acquisition of two surface-level parking lots that are owned by Home Depot and used for parking by their customers. Although it has not yet been determined, the loss of parking associated with Alternative 5.1.2 may require the displacement of the Home Depot hardware store if replacement parking is not provided.

Construction of the Lander 3 (Diagonal) station would require acquisition of six commercial properties with five retail businesses.

If the Operations Center were located in the SODO area, it would require acquisition of six commercial/industrial properties that house five businesses. This alternative would result in the displacement of 283,057 square feet of developed space. Businesses on this site include industrial and retail activities, including the Home Depot, Washington Chain Supply, Ederer Crane, All Metals Fabricators, and St. Vincent De Paul Mattress.

SODO Preferred Alternative

The Preferred Alternative serving the Pioneer Square, Chinatown/International District and SODO areas would involve 29 property acquisitions, including six full acquisitions, four partial acquisitions, and air rights or easements for 19 properties. The alternative includes Weller/King Street Station 2 with two partial acquisitions of public property (owned by the Public Stadium Authority), the Safeco Field 1 station and switches area, (partial acquisition of WSDOT-owned property), and the Lander 3 station with six full commercial property acquisitions. The business displacements would occur in this area, with five business relocations expected for the Lander 3 station.

The guideway for the Preferred Alternative would require air rights and easements in several locations, including three parcels north of the Weller/King 2 station; two of these parcels are owned by King County, and one is railroad right of way owned by Burlington Northern Santa Fe Railroad (BNSF). Similarly, the diagonal route for the guideway transitioning from Third Avenue S toward Utah Avenue S would cross over six parcels, including parcels owned by Seattle Public Schools and BNSF. The

guideway south from the Lander 3 station would also pass over the SODO/Starbucks Center parking lot at First Avenue S and S Lander Street to reach the alignment along Utah Avenue S, requiring air rights or easements for a portion of that property. Similarly, air rights or easements would be required for the guideway crossing above two properties along S Horton Street, including a Port of Seattle-owned parcel used for a maintenance facility.

4.2.2.7 Segment 6: West Seattle Segment

Up to 38 properties in West Seattle could be affected by construction of the Green Line, including up to 16 full acquisitions. The alternatives in this segment, which include several subalternatives focused on the Delridge, Avalon, Alaska Junction and California to Morgan Junction sections of the route. These estimates are based on a representative selection of the subsegment and station alternatives that would comprise a full alignment alternative for the West Seattle segment. Depending on the alignment or station alternative, the totals and properties affected would vary slightly but would remain within the ranges and locations identified. Several modified subsegments (including Alternatives 6.3(s), 6.4, 6.4(s) and 6.5) have also been evaluated for the Final EIS. As they do not make up a full-length alternative for the segment, the comparison of their impacts is made by subsegment against similar sections of the full-length alternatives 6.1, 6.2 and the Preferred Alternative.

Alternative 6.1 (West Seattle I) could require full acquisition of 14 properties, including eleven commercial properties and three residential properties. Alternative 6.1.2 would require partial acquisition or easements within the West Duwamish Greenbelt (in the area commonly called Pigeon Point) for guideway columns; the number and location of columns would be determined during project design.

Alternative 6.2 (West Seattle II) could affect 36 properties, with seven full acquisitions, four partial acquisitions, and air rights or easements for 25 properties. This alternative would involve displacements for 3 to 4 businesses and up to three residences. Alternative 6.2 would also involve easements or air rights from the City of Seattle, the Port of Seattle and others for the bridge to the north of the existing West Seattle Bridge.

The Preferred Alternative for the West Seattle Segment would affect 21 properties, including six full acquisitions, one partial acquisition, and 14 properties involving air rights or easements. The acquisitions would require relocating four businesses, but no residences would be affected.

Delridge. The Delridge area consists of the alignment and stations from the West Seattle Bridge up to SW Avalon Way at SW Genesee Street. A comparative section of Alternative 6.1 would involve up to 12 properties, including eight full acquisitions.

Alternative 6.2 in this area would involve six acquisitions, with no full acquisitions. The Alternative 6.2 alignment also crosses the Nucor Steel Plant, a storage facility, and two other commercial properties.

Alternative 6.3(s), the Delridge North subsegment (Preferred Alternative) involves an alignment north of the Nucor Steel plant and then southward along SW Avalon Way, with two partial property acquisitions. The guideway for Alternative 6.3(s) would involve an easement from the City of Seattle (Fire Department), and the remainder of the subsegment alignment would be along street rights-of-way and the north end of the Nucor property.

Alternative 6.4 (West Seattle/Andover to Yancy subsegment) with Delridge 1A station would have 11 property acquisitions, including seven partial acquisitions and air rights, and four full acquisitions. Alternative 6.4(s), with no Delridge station, would affect 12 properties, including air rights for one

additional property due to a switch location, but the other acquisitions would be the same as for Alternative 6.4.

Alternative 6.5 (Genesee) with a Delridge 4 station, would affect 13 properties, including nine full acquisitions. Full acquisition would affect six residential properties, and three commercial properties. A partial acquisition of a commercial property housing a Department of Social and Health Services (DSHS) office would also be needed.

In a comparison of the stations in this area, Delridge 1, 1A (26th) and 2 could acquire a portion of a large parcel housing two parking lots and an office building; one of the parking lots would be acquired for the station. Delridge 3 would occupy portions of the Nucor Steel Mill, a large parcel. Delridge 4 would partially occupy a portion of a commercial property housing a DSHS office.

Avalon. The subsegment alternatives in this area include the alignments along Fauntleroy Way SW or 35th Avenue SW and SW Alaska Street. For Alternative 6.1, which could utilize either the northwest or southwest sides of Fauntleroy Way SW, five parcels would be affected. The Avalon 1 (Center) station could require acquisition of three properties housing fast food restaurants.

For Alternatives 6.2 (East side of 35th and center of Alaska) and 6.2.1 (East side of 35th and north of Alaska), five properties are affected. The guideway from SW Avalon Way and 35th would require a residential property (a triplex) and a vacant parcel. The Avalon 2 (35th) station option could require partial acquisition of a portion of one public property (West Seattle Stadium Park), and the guideway from 35th Avenue SW to SW Alaska Street would acquire the property housing the West Seattle Herald, and air rights or easements would be needed for a third property.

For Alternative 6.2.2, along the center of 35th Avenue SW and north side of SW Alaska Street (Preferred Alternative), four properties would be affected. The Avalon 2B station would acquire a vacant commercial property, and the guideway would fully acquire two properties, including the West Seattle Herald property and an office building. Air rights or easements would be needed for a third property.

Alaska Junction. The Alaska Junction station could require acquisition of either two or three commercial properties, depending upon the alternative chosen. The Alaska Junction 1 (42nd/Edmunds) alternative could require acquisition of a medical/dental office and a parking lot, while the Alaska Junction 2 (44th/California) alternative could require acquisition of three parcels used for parking.

Alternative 6.1 would affect 11 properties, including full acquisition of two properties for the Alaska Junction 1 (42nd/Edmunds) station, with displacements noted above. The guideway to this station would cross above nine other properties, requiring air rights or easements.

Alternative 6.2 would affect also affect 11 properties, including full acquisition of three properties (all parking lots) for the Alaska 2 station. The guideway would cross over eight other properties, requiring air rights or easements.

The Preferred Alternative would affect 12 properties, including full acquisition of two properties for the Alaska Junction 1 (42nd/Edmunds) station, displacing a medical/dental office and a parking lot. The guideway would cross above ten other properties, requiring air rights or easements.

Morgan Junction. Acquisitions in the Morgan Junction station area, which also includes the alignment along California Avenue SW, is focused primarily at the Morgan Junction station. Stations in this area would include acquisition of one commercial property under Morgan Junction 1 and 1A (West), housing two businesses. Morgan Junction 2 (Center) could affect three properties: full acquisition of one

commercial property, housing a gas station/convenience store, partial acquisition of one commercial property (a portion of a grocery parking lot), and partial acquisition of one multifamily parcel.

Alternative 6.1 would affect four properties in this area, including the one commercial property under Morgan Junction 1 (West), housing two businesses, as well as three commercial properties with air rights for switches near California Avenue SW.

Alternative 6.2 would affect three properties in this area, with the Morgan Junction 2 (Center) station requiring full acquisition of one commercial property, housing a gas station/convenience store, partial acquisition of one commercial property (a portion of a grocery parking lot), and partial acquisition of one multifamily parcel.

The Preferred Alternative in this area, 6.1.6(s), would affect three properties, including one commercial property under Morgan Junction 1A (West) housing two businesses, as well as two properties with air rights for switches on California Avenue SW.

West Seattle Preferred Alternative

The Preferred Alternative to serve the West Seattle community would affect 21 properties, including 6 full acquisitions, one partial acquisition, and 14 air rights or easements. In the Delridge North subsegment, the alignment around the Nucor Steel plant and then southward along SW Avalon Way would involve two partial property acquisitions, including a portion of the Nucor property. The guideway would involve an easement from the City of Seattle (Fire Department), with the remainder of the subsegment alignment along street rights-of-way and the north end of the Nucor property.

In the Avalon area, four properties are affected; the Avalon 2B station would acquire a vacant commercial property, and the guideway would fully acquire two properties, including the West Seattle Herald and a vacant parcel. Air rights or easements would be needed for a third property. In the Alaska Junction area, the Preferred Alternative would affect 12 properties, including full acquisition of two properties for the Alaska Junction 1 (42nd/Edmunds) station, displacing a medical/dental office and a parking lot. The guideway would cross above ten other properties, requiring air rights or easements. Along California Avenue SW to Morgan Junction, the Preferred Alternative would affect three properties, including one commercial property under Morgan Junction 1A (West), housing two businesses, as well as two properties with air rights for switches on California Avenue SW.

4.2.2.8 No Action Alternative Impacts

Under the No Action Alternative, the Green Line would not be built and SMP would not acquire any properties for construction of the Green Line. Current property owners would be free to use and develop their property to the highest and best use as allowed by zoning code.

4.2.3 Mitigation

SMP plans to mitigate the impacts of property acquisition associated with constructing and operating the Green Line by acquiring all property at fair market value and providing relocation assistance to property owners and qualified tenants. As noted above, the agency has adopted Real Property Acquisition and Relocation Policies, Procedures, and Guidelines to provide consistent treatment, to minimize hardship of persons and businesses displaced as a direct result of the project, and to seek cooperative settlements of property acquisitions and relocation claims.

The Green Line could require acquisition of a maximum of ten single-family residences and six multifamily residences with up to 98 units or as few as no residences (depending on alternatives selected).

Property owners would receive fair market value for their property, as described above. Residents, including owners and qualified tenants, would also receive relocation assistance, including compensation for moving costs and aid in finding new residences. If the rent of the alternative housing exceeds a tenant's current rent, SMP would provide assistance, in accordance with applicable law. Under extreme cases where tenants to be relocated have extremely low incomes and cannot otherwise afford replacement housing, SMP could be required to provide housing, although with vacancy rates exceeding nine percent, this is not anticipated. In any case, all housing units acquired under this program are decent, safe, and sanitary. SMP is committed to ensuring that replacement housing is available to displaced persons, regardless of age, gender or race. [None of the properties potentially affected by the project are in the Low Income Public Housing Program or the Seattle Senior Housing Program (Seattle Housing Authority 2003). It is not known if any of the residential units are covered under the Housing Choice Voucher Program (Section 8).]

Owners of nonresidential properties would receive fair market value for their properties, as well as relocation assistance if the property is owner occupied. Qualified tenants would also receive relocation assistance. This assistance would include relocation-planning services, payment for reasonable moving and related expenses, and reestablishment expenses. Reestablishment expenses may include:

- Repairs or improvements to the replacement real property as required by federal, state, or local law, code, or ordinance.
- Modifications to the replacement property to accommodate the business operation.
- Construction and installation costs for exterior signing to advertise the business.
- Provision of utilities from right-of-way to improvements on the replacement site.
- Redecoration or replacement of soiled or worn surfaces at the replacement site.
- Licenses, fees, and permits when not paid as part of moving expenses.
- Feasibility surveys, soil testing, and market studies.
- Advertisement of replacement location.
- Professional services in connection with the purchase or lease of a replacement site.
- Estimated increased costs of operation during the first two years at the replacement site for such items as:
 - Lease or rental charges.
 - Personal or real property taxes.
 - Insurance premiums.
 - Utility charges.
 - Impact fees or one-time assessments for anticipated heavy utility usage.

4.2.4 Significant Unavoidable Adverse Impacts

Acquiring property for the Green Line is not anticipated to result in a significant unavoidable adverse impact on the human environment. Because the guideway would be elevated and would run primarily on public right-of-way, the number of properties to be acquired is limited. Purchasing property at fair market value, as required by law, and providing relocation assistance, as established in SMP policy, could mitigate direct financial impacts to property owners and tenants associated with property acquisition.

4.3 LAND USE AND NEIGHBORHOODS

The purpose of this section is to identify and evaluate impacts to land use and neighborhoods in which the Green Line alternative alignments would be located and to adopted land use and shoreline plans and policies. The land use and neighborhood impacts analyzed in this section include direct and indirect impacts.

Direct impacts to land use and neighborhoods could include the consequences that would result from the development of monorail facilities, particularly those resulting from the acquisition of properties for station facilities, guideways, or the Operations Center or other facilities, as well as by the changes in access, transportation service, and parking due to the placement of the guideway within the public street rights-of-way. Indirect impacts to land use and neighborhoods could also result, although they may occur later in time or as a consequence of impacts to other aspects of the environment. Indirect impacts could include longer-term effects related to changes in the pattern of land use, population density, growth rate, and traffic levels. Noise, visual, and air quality impacts have also been considered (see Sections 4.5, 4.6, and 4.7) to determine if those impacts would be so great as to have a significant indirect impact on land use or neighborhoods.

Land use impacts consider the magnitude of the change in the pattern of existing and planned land uses that could result from the implementation of the Green Line project alternatives, would conflict with, or otherwise preclude opportunities to achieve, the intent of adopted or proposed land use and shoreline plans, policies, controls, and goals and objectives.

The neighborhoods analysis addresses community characteristics and populations. Significant direct, physical impacts to a neighborhood could occur if the construction and operation of a proposed project destroys or displaces a significant portion or functional area of the neighborhood, such as a large number of residences, an important commercial area, or a public, cultural or other community resources of significance to the neighborhood, including places of worship and community centers or service facilities. Other direct impacts considered include whether the project physically or functionally divides one part of the neighborhood from other parts of the neighborhood in a way that affects the neighborhood's ability to function as a coherent community. Proximity or indirect significant impacts to a neighborhood occur if the proximity impacts of the project (noise, traffic, construction, etc.) are so severe that the project significantly changes the nature of the neighborhood, if the neighborhood cannot continue to effectively function as a coherent community, or if living or working near the project is so onerous that an urban blight situation is created. The height, bulk, and scale of Green Line structures were also considered in terms of their contrast with existing or planned community features. Particular proximity impacts are discussed in more detail, and with respect to specific areas rather than to the entire community, in the following sections:

Section 4.1, Transportation (including traffic, parking, transit, pedestrians, and bicyclists)

Section 4.2, Displacements and Relocation

Section 4.4, Economics (including business and employment)

Section 4.5, Visual and Aesthetic Resources

Section 4.7, Noise and Vibration

Section 4.9, Public Services and Utilities (including educational facilities, community facilities, and public health and safety)

Section 4.10, Parks and Recreation

Section 4.11, Cultural Resources

Probable impacts are discussed in Section 4.3.2. Consistency with plans and policies is summarized in Section 4.3.5 and more detail is provided in Appendix U of the Draft EIS.

4.3.1 Affected Environment

The City of Seattle's Comprehensive Plan adopts an urban village strategy for preferred growth in Seattle neighborhoods. Urban villages are those areas that have been identified as conducive to pedestrian and transit use and to cohesive community development. Under the Washington Growth Management Act, the City's zoning and shoreline codes are tailored to be consistent with the goals and policies of the Comprehensive Plan.

Transit uses are strongly encouraged in Seattle's Comprehensive Plan, particularly transit systems (including intermediate-capacity transit systems such as the Green Line) that connect urban centers, urban villages, and manufacturing/industrial centers. The Green Line would connect the City's urban center with the urban villages of Crown Hill, Ballard, Alaska Junction (called West Seattle Junction in the Seattle Comprehensive Plan), and Morgan Junction, and with the Ballard/Interbay and SODO/Duwamish manufacturing/industrial centers. A detailed discussion of the City's Comprehensive Plan policies and neighborhood plan policies is included as Appendix U to the Draft EIS.

The Comprehensive Plan also adopts a Transit Priority Network for the City of Seattle, which includes the general route of the Green Line from Crown Hill and Ballard through Interbay, Downtown, and SODO, to West Seattle and its Alaska and Morgan Junctions.

The pattern of existing land uses along the Green Line alternative alignments includes a mix of commercial (neighborhood commercial and a regional center), residential (primarily multifamily), institutional, industrial, and park uses. The existing land uses within the corridor are for the most part consistent with Seattle's Comprehensive Plan, neighborhood plans, and zoning.

Overall population in the City of Seattle is 563,374 (2000 U.S. Census), of which 25 percent are minorities and 15 percent are below the poverty line. Table 4.3-1 provides a summary of the population, racial/ethnic, and income distribution of the populations in census block areas that have at least a portion of the block group near the Green Line alignment, station, and Operations Center alternatives. A more detailed analysis of the demographic characteristics of communities along the project corridor and the effects of the project on minority and low-income populations are evaluated in Appendix A, Environmental Justice. The neighborhood analysis also took into account comments and information received from neighborhood groups and individuals during project scoping, as well as the results of ongoing community outreach to help identify valued characteristics, facilities, and resources within neighborhoods along the Green Line alignment.

4.3.1.1 Segment 1: Ballard Segment

Ballard Segment Alignment Alternatives

The general pattern of existing land use along both Ballard alternative alignments (Alternatives 1.1 and 1.1(s) (West Side of 15th) and 1.2 (Center of 15th)) is commercial (office, retail, service, and restaurants) interspersed with mixed use multifamily residential. This commercial strip expands near the intersection of NW 85th Street and 15th Avenue NW, but is otherwise relatively narrow north of NW 65th Street, with single-family and multifamily residences on small lots beginning on 15th and 17th Avenues NW. Ballard High School is on 15th Avenue NW, near NW 65th Street. South of NW 65th Street, commercial uses intensify and areas within a block or two of the alignment alternatives are characterized by a mix of uses, including multifamily residential and some single family residences. South of NW Market Street and

approaching the Ballard Bridge, larger commercial, industrial, and warehouse facilities are the dominant existing land use.

**Table 4.3-1. Summary of Population and Demographic Characteristics
2000 Census Areas on or near Green Line Alternatives**

Segment	Population	Percent Racial Minorities by Tract*	Percent Below Poverty Line by Tract*
Ballard	9,218	7% to 20%	1% to 22%
Interbay	5,381	13% to 18%	5% to 15%
Queen Anne/Seattle Center/Belltown	5,500	12% to 25%	6% to 18%
Downtown	5,095	25% to 43%	25% to 63%
SODO	2,553	39%	13% to 49%
West Seattle	13,760	10% to 36%	4 to 16%
Total	41,507	--	--

Note: Represents the range of percentages within each of the 3 to 10 Census Tracts comprising the Green Line route in each segment. The analysis used existing census boundaries to identify the likelihood of large concentrations of minority or low-income populations that could be affected by the project.

Zoning for all alignment alternatives is predominantly Neighborhood Commercial, Commercial, and General Industrial. Figure 4.3-1 and Table 4.3-2 show land use, zoning, and shoreline designations in the Ballard Segment. Overall, planned land uses in the area do not envision substantial departures to the existing land use characteristics, although they support increased densities and emphasize the importance of maintaining existing commercial and industrial areas. From Crown Hill to near NW Market Street, the land use and zoning designations along 15th Avenue NW allow higher density and mixed uses than the blocks immediately to the east or west. The land use and zoning designations for the area surrounding the intersection of NW Market Street and 15th Avenue NW envisions comparatively increased density of commercial uses than the uses to the north, and to the south the area transitions to general industrial designations.

Waterfront uses for the West Bridge alignment alternative (1.1.1) on the north side of the Ship Canal, include ship moorage and an antique store on Shilshole Avenue NW immediately west of the Ballard Bridge overpass. The Far West Bridge alignment alternative (1.1.2) would cross over the approximately 13-acre Ballard Mill properties site, the primary uses of which are warehousing and moorage. The East Bridge alignment alternative (1.2) would cross over an undeveloped site that is part of the Seattle Community College Maritime Training Center and a five-story commercial building.

The Ballard neighborhood is a residential and maritime neighborhood known for its Scandinavian roots. About 9,218 people live in the census tracts along the Green Line (2000 U.S. Census) in Ballard, of which 7 to 20 percent are minorities, and one to 22 percent are below the poverty line. The northern neighborhoods of the Ballard Segment (Crown Hill and Ballard) joined together as the Crown Hill/Ballard Neighborhood Planning Association (CH/B NPA) to develop a neighborhood plan. The Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) Neighborhood Plan provides a plan for the industrial and maritime area surrounding the Lake Washington Ship Canal. BINMIC is one of only two designated manufacturing and industrial centers in Seattle, the other being in the SODO Segment. The plan emphasizes the preservation of industrial land and jobs. Although some pedestrian activity occurs around the commercial centers, transportation in Ballard is primarily auto- and transit-oriented.

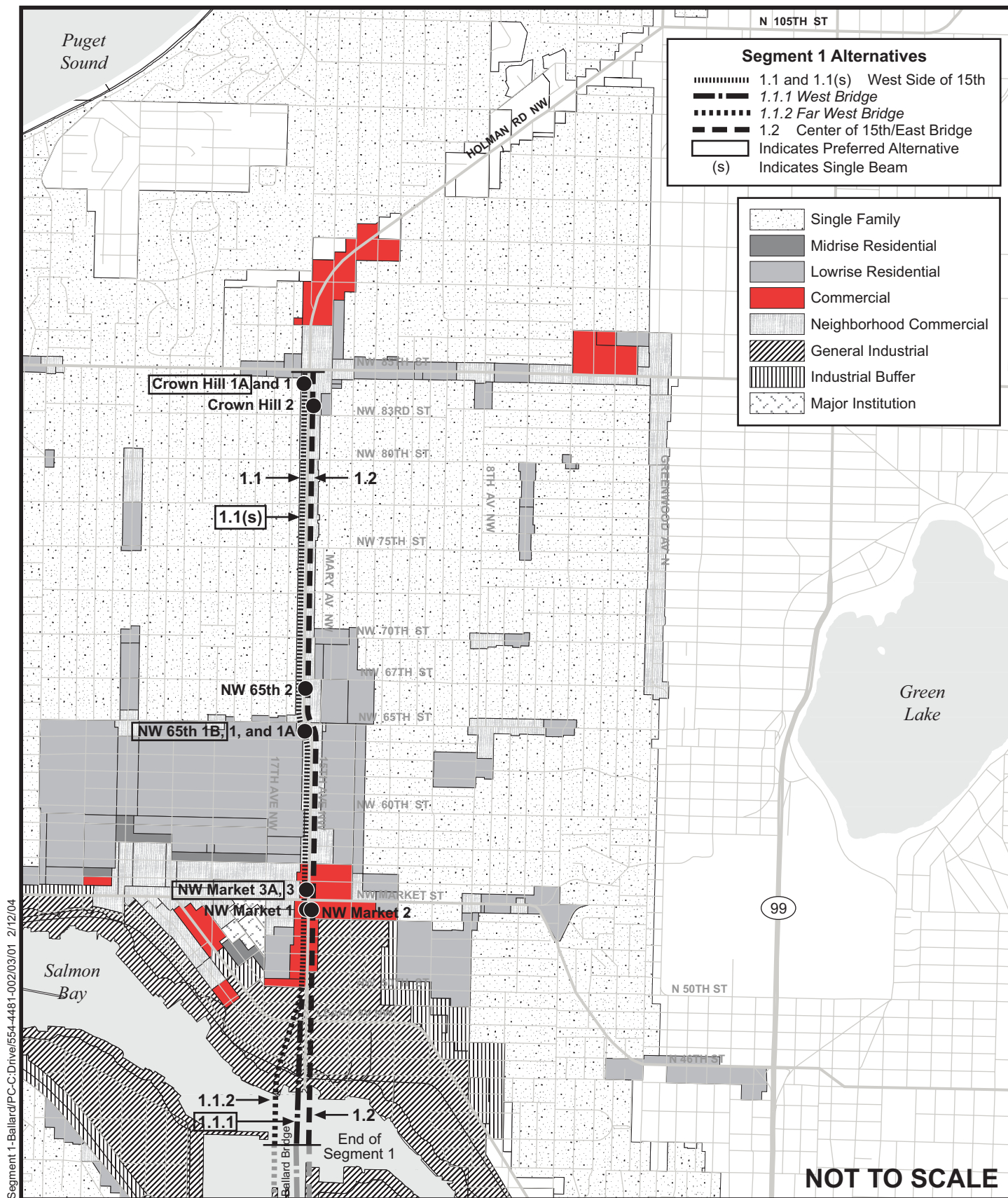


Figure 4.3-1
Segment 1: Ballard
Land Use, Zoning, and
Shoreline Designations

Table 4.3-2. Ballard Land Use, Zoning, and Shoreline Designations

Alignment Segment	Primary Land Use	Primary Zoning/Shoreline Designation
15 th Avenue NW/NW 85 th Street	Neighborhood commercial, single family	NC3-40, SF5000
15 th Avenue NW south to NW 65 th Street	Neighborhood commercial, single family	NC2-40, SF5000
15 th Avenue NW south to NW Market Street	Neighborhood commercial, multifamily	NC3-40, L-3, L-2, L-1, LDT
15 th Avenue NW/ NW Market Street	Neighborhood commercial, manufacturing/industrial	NC3-85, NC3-65, C1-65, IG2 U/65
15 th Avenue NW south to Ballard Bridge	Manufacturing/industrial	IG2 U/65
NW 46 th Street/15 th Avenue SW	Manufacturing/industrial	IG 2 U/65, UI shoreline

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., NC3-40 and IG2 U/65).

Source: City of Seattle (2003).

Crown Hill Station Alternatives

The Crown Hill station area is characterized by retail and service-oriented uses similar to other residential urban village business districts in Seattle. Community resources in the vicinity of the Crown Hill station alternatives include Fire Station 35, Baker Park on Crown Hill, Shine Bright Montessori School, Whitman Middle School, North Beach Elementary School, Loyal Heights Elementary School, and Whittier Elementary School. Single family homes exist on properties within the block to the east and west of 15th Avenue NW. Zoning around the station area is NC3-40, with lowrise (L2) and single family zoning further to the east and west.

Crown Hill 1 and 1A (West, 85th). Representative land uses in the immediate area of the Crown Hill 1/1A station alternative are multifamily residential, a Safeway grocery store, a Walgreens drugstore and QFC grocery store, three-story apartment buildings, a number of restaurants, a millwork establishment, and smaller retail and service uses such as a karate studio and stamp/coin shop. There are also two billboards at the intersection of NW 85th Street and 15th Avenue NW. There are also single family residences to the west of the site.

Crown Hill 2 (Center). The Crown Hill 2 station alternative is near one- to two-story commercial/retail businesses (in some cases occupying former single-family residences). These types of commercial/retail businesses generally extend south on 15th Avenue NW to the next station location at the intersection with NW 65th Street. Specific uses include a Washington Mutual Federal Savings bank and restaurants.

Land uses within the vicinity of proposed station locations are single-family residential with a mix of multifamily residential closer to the commercial uses at the neighborhood business centers.

NW 65th Station Alternatives

The NW 65th station alternatives are near the Ballard High School and Ballard Swimming Pool, but the NW 65th 2 (Center) station alternative is closer than the other alternatives to those uses. The area also includes retail and service businesses, with residential uses further to the east and west. Another community resource in the vicinity of the NW 65th station includes Salmon Bay K-8 School. Zoning in

the area is NC2-40 along 15th Avenue NW and in areas around the intersection with NW 65th Street. Multifamily-zoned areas (L2 and L3) extend to the east. Lowrise and lowrise duplex/triplex areas extend to the west and southwest, with single family zoning to the northwest.

NW 65th 1, 1A, and 1B (West). Land uses in the immediate area of NW 65th 1/1A/1B include a four-story office building and retail business plaza and a three-story apartment building. Areas to the west of the site are characterized by lowrise duplex/triplex uses. Ballard High School is to the northeast.

NW 65th 2 (Center). The station would be located south of NW 67th Street in the center of 15th Avenue. Major uses near NW 65th 2, which is near NW 67th Street, include the Ballard Swimming Pool and Ballard High School, as well as retail and commercial businesses. There are single family residences and lowrise multifamily development within one-half block to the west.

NW Market Station Alternatives

The intersection of NW Market and 15th Avenue NW is characterized by a wide variety of commercial retail and service uses and serves as the retail gateway to the main Ballard business area along NW Market Street to the west. All Green Line station alternatives would be located at the intersection of NW Market Street and 15th Avenue NW. Land uses in the immediate area include a grocery store, a service station, restaurants, and bowling lanes in the northeast quadrant, Denny's restaurant in the northwest quadrant, and Walgreens in the southwest quadrant. Zoning in the station vicinity is C1-65, with NC3-85 and NC3-65 zones further to the west

Land uses within one mile of the station location are primarily retail and office uses, with a mix of multifamily residential and high-density single-family residential uses to the northwest and northeast. St. Alphonsus Catholic Church and school are located two to three blocks north, at 15th Avenue NW and NW 58th Street. Marine, industrial, and warehousing operations characterize the area south of the proposed station locations to the Ship Canal, interspersed with retail and restaurant uses. The Ballard/Swedish Hospital campus is located south of NW Market Street approximately four blocks west of the NW Market station alternatives. Other community resources in the vicinity of the NW Market station alternatives include Greg's Garden, 14th Avenue NW Boat Ramp, Fire Station 18, Seattle Maritime Academy, St. Alphonsus School, and Pacific Crest School.

Ballard Crossing

Maritime uses near the Ship Canal, light to heavy manufacturing, and warehousing characterize much of the land use within the BINMIC area near the Green Line alternatives. Existing land uses in the vicinity of the Ballard Bridge consist of industrial and warehouse uses, although some retail and other uses (such as Mike's Chili Parlor, a historic building) exist.

4.3.1.2 Segment 2: Interbay/Magnolia Segment

Interbay Segment Alignment Alternatives

All Green Line alignment alternatives in the Interbay area would travel through an urban industrial center characterized by a mix of commercial/manufacturing businesses and would follow one of the major north/south arterial transportation corridors in the City, which serves high volumes of vehicular travel and also is a major bus transit and truck corridor. The Burlington Northern Santa Fe (BNSF) railroad traverses the area, with frequent freight and passenger rail trains and the potential for commuter rail trains to use the line in the future. There are growing multifamily residential areas near the W Dravus Street area, on the west slope of Queen Anne, and in the vicinity of Elliott Avenue W and W Mercer Street.

There is some open space on the western-facing steep slopes of Queen Anne Hill. The athletic fields near W Dravus Street, Interbay Athletic Complex, and Interbay P-Patch provide recreational opportunities.

Much of the area immediately to the south of the Ship Canal is developed with industrial uses oriented to the waterfront. To the west of the bridge is the Port of Seattle Fishermen's Terminal area, which includes docks and moorages, office and industrial uses, a Seattle Fire Department dock, and a marine railway and ship repair facility. The railway is connected to the POS ship repair facility and is used for boat haul-out. Alternative 2.1/2.1(s) (west side of 15th/Center of Elliott) includes a route option (2.1.1, West Bridge Connection) to connect to the West Bridge alignment alternative (1.1.1). Land uses immediately in the area include marine railways and two small welding shops operated by Fishing Vessel Owners Marine Ways Inc. Option 2.1.2, Far West Bridge Connection, would cross Dock 4, Seattle Ship Supply, and several warehouse uses. The Seattle Ship Supply building is currently vacant and for lease. Alternative 1.2 (Center of 15th/West Side of Elliott) would also stay to the east of 15th Avenue W, but would still cross over privately owned industrial properties immediately to the south of the Ship Canal, as well as several commercial properties.

South of the Ballard Bridge, the pattern of land uses along all the Green Line alignment alternatives includes multifamily residential; commercial (retail, service, and office); manufacturing, distribution, and warehousing; Port of Seattle industrial uses; institutional uses (including a small church); and recreational facilities (including the golf driving range). While the uses fronting 15th Avenue W are primarily retail and industrial, residential properties predominate on the blocks immediately to the east. To the west, the land uses are primarily industrial, commercial, or recreational. Land uses along Elliott Avenue W include Terminal 86 (a 40-acre site characterized by 68 silos, 130 feet tall), warehouse facilities, commercial (retail and office), vacant or underdeveloped properties, and high-rise multifamily residential complexes along the southwest slope of Queen Anne Hill. The Amgen (formerly Immunex) campus is also under construction on a site between the railroad tracks and Terminal 86. Fourteen-acre Kinnear Park is located across Elliott Avenue W on the west slope of Queen Anne Hill and significantly uphill from all the Green Line alignment alternatives.

Zoning along the alignment alternatives in this segment is predominantly General Industrial, Industrial/Commercial, and Commercial. Figure 4.3-2 and Table 4.3-3 show land use, zoning, and shoreline designations in the Interbay Segment.

Table 4.3-3. Interbay/Magnolia Land Use, Zoning, and Shoreline Designations

Alignment Segment	Primary Land Use	Primary Zoning/Shoreline Designation
Ship Canal Bridge	Waterway	IG1 U/45, UM, UI and CN shorelines
15 th Avenue W to W Emerson Street	Manufacturing, warehousing	IG1 U/45, IG2 U/45
W Dravus Street station	Commercial	C2-40
15 th West to Elliott Avenue West	Commercial, manufacturing	C2-40, C1-40,
Elliott Avenue W to W Harrison Street	Manufacturing, commercial	IC-45
Elliott and Mercer- station	Manufacturing, commercial	IC-45

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., C2-40 and IG2 U/45).

Interbay is part of the BINMIC neighborhood, whose neighborhood plan is described above in the Ballard Segment. The commercial core of the Interbay neighborhood is flanked by the Magnolia and Queen Anne residential neighborhoods, and Interbay's services and transportation infrastructure serve those neighborhoods. About 5,381 people live in the census tracts along the Green Line (2000 U.S. Census) in Interbay, of which 13 to 18 percent are minorities and 5 to 15 percent are below the poverty line.

Although there is some multifamily housing in Interbay, land uses are primarily industrial and commercial. Transportation in the area is auto- and transit-oriented.

Dravus Station Alternatives

The immediate area of the Dravus station alternatives is characterized by a variety of commercial (retail, warehouse), light manufacturing, and recreational (golf course/driving range) uses. Community resources include Fire Station 23, Lawton Elementary School, Interbay Covenant Church, Interbay Athletic Complex, and Interbay P-Patch. Mixed warehouse uses and the Interbay Covenant Church are located across 16th Avenue to the west of the 16th Avenue NW. Representative uses near 16th Avenue W and W Dravus Street include a convenience store, a service station, a QFC grocery store, and nearby office and restaurant uses. The north end of the Interbay Athletic Complex is one block south of the Dravus 1 and 1A station location, and less than a block from Dravus 1B. The Dravus 2 station location is on the northwest corner of 15th Avenue W and W Dravus Street, one block east of the Dravus 1 station location. Saint Margaret's Church is located approximately two blocks east of the intersection, on the northeast corner of W Dravus and 14th Avenue W. Multifamily residential buildings are located to the east of 15th Avenue W on the west slope of Queen Anne Hill. Land uses within 1/2 mile of the station locations are generally manufacturing, commercial, and low-rise multifamily residential. Zoning is commercial, with C1-40 zoning along 15th Avenue W, C2-40 zoning to the west, and NC3-40 zoning to the east of 15th Avenue W.

Howe Station Alternative

The immediate area of the Howe station alternatives is characterized by mixed office/retail/warehouse uses. Community resources in the area near Howe station include Kinneer Park, Southwest Queen Anne Greenbelt, Fire Station 41, Coe Elementary School, McClure Middle School, and Seattle Country Day School. The largest property in the area is the former Tsubota Steel facility, which is primarily unused at this time. Port of Seattle Terminal 91 facilities are located further to the west. The Magnolia Bridge is located approximately 600 feet south of the proposed station location. Businesses in the vicinity of the Magnolia Bridge include hardware/appliance retail and wholesale businesses. Multifamily residential uses are located primarily to the east of 15th Avenue W on the west slope of Queen Anne Hill, with a view over the station area toward Elliott Bay and Magnolia, but these uses are separated from the station area by a steep slope area and limited street connections. Land uses within 1/2 mile of the station location are generally manufacturing, commercial, and low-rise multifamily residential. Zoning is industrial (IG2) along the west side of 15th Avenue W and further west, with less intensive industrial zoning along the east side of 15th Avenue W (IB and IC-45).

Interbay Operations Center Alternative

The site of the Interbay Operations Center alternative (C-1) is a parcel of approximately 6.5 acres that is currently occupied by the Northwest Center, a non-profit warehouse and office building. The Interbay Athletic Complex and Interbay P-Patch are located north of the site, and the National Guard Armory and a large parking lot are located immediately to the south. Uses on the east side of 15th Avenue W are the Elliott Bay Animal Hospital and the GM Nameplate plant, with multifamily and single-family residential uses higher on the west slope of Queen Anne Hill. Land uses in the vicinity are generally manufacturing, commercial, and low-rise multifamily residential. The zoning of this Operations Center alternative is industrial (IG-2).

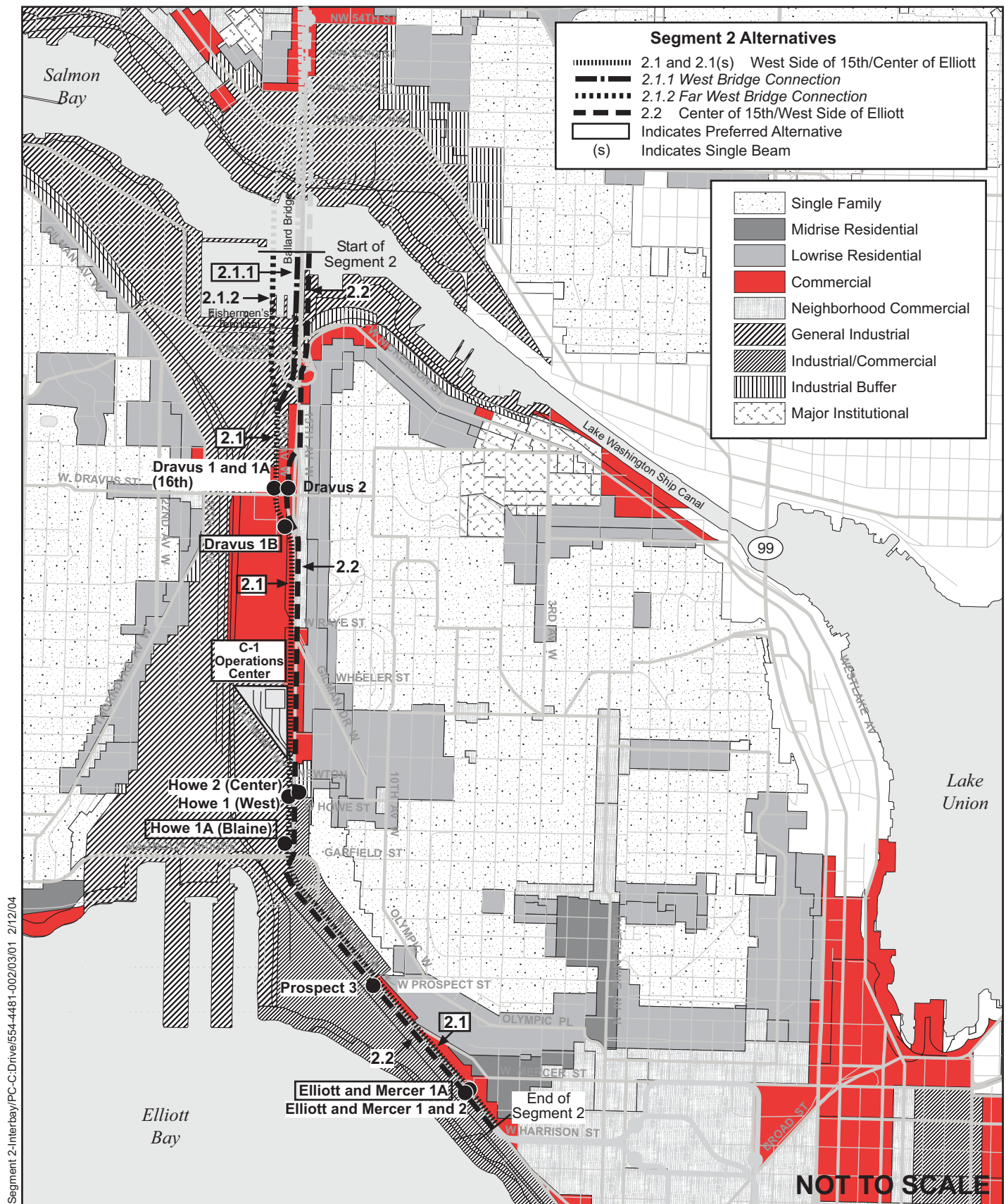


Figure 4.3-2
Segment 2: Interbay/Magnolia
Land Use, Zoning, and
Shoreline Designations

Prospect Station Alternative

The area of the Prospect 3 (West) station alternative is primarily characterized by warehousing and light manufacturing. The developing Amgen biotechnology campus is located further to the west and would be most easily accessible from this potential station location. The Southwest Queen Anne Greenbelt is located on the hillside across Elliott Avenue W to the east, with multifamily residential uses further to the east. Land uses within 1/2 mile of this station location are primarily warehouse and light manufacturing with multifamily residential uses at the top of a steep vegetated slope across Elliott Avenue to the east. Zoning in this area is industrial-commercial (IC-45).

Elliott and Mercer Station Alternatives

The immediate area of the station alternatives—Elliott and Mercer 1 (Center), Elliott and Mercer 1A (Center), and Elliott and Mercer 2 (West)—is characterized by multifamily residential, office, warehousing, manufacturing, and small retail/service. This area has already attracted significant new mixed-use and multifamily development to the east, and zoning capacity allows additional development in the area. Uses in the area include the Elliott West office building, a tire store, and mid-rise apartment buildings. Land uses within 1/2 mile of the station location are generally commercial and low-rise multifamily residential. Community resources near the Elliott and Mercer Station include St. Anne School, Fire Station 8, and John Hay Elementary. Zoning along the west side of 15th Avenue W in this area is industrial-commercial (IC-45) with commercial zoning (C2-40) to the east side of that roadway. Immediately uphill to the east, and separated from this commercial corridor by slopes, the lots are zoned midrise residential (MR) with 60 foot height limits.

4.3.1.3 Segment 3: Queen Anne/Seattle Center/Belltown Segment

Commercial office, retail, high-density residential, cultural, and recreational land uses broadly characterize the Queen Anne/Seattle Center/Belltown Segment. Residential, cultural, and recreational facilities associated with Seattle Center are the primary uses in the vicinity of W Harrison Street.

Seattle Center. All Green Line alternatives would travel through or adjacent to the Seattle Center, which is characterized by a variety of cultural, entertainment, and sports venues, as well as open space for multiple uses. Approximately 6.5 million people visit Seattle Center each year. Seattle Center includes eleven general areas: the Mercer theater district, Fifth Avenue parking, Key Arena, International Fountain Mall, Memorial Stadium, Fun Forest (a commercial amusement park), Experience Music Project (EMP), Seattle Children's Theater, Mural Amphitheatre, Broad Street Green, and Pacific Science Center. There are approximately 32 acres of green and open space. Within these zones are housed many of the City's arts and cultural venues, including the Seattle Opera, Pacific Northwest Ballet, Seattle Children's Theater, Pacific Science Center, EMP, Bagley Wright Theater, Intiman Theater, Memorial Stadium, the Center House, Key Arena, and Marion Oliver McCaw Hall. Seattle's most recognizable landmark, the Space Needle, is located in the Seattle Center, and the existing Seattle Center Monorail is a significant feature of the Center. Built for the Seattle World's Fair, the Seattle Center Monorail runs from a terminal located at the Center House, through the EMP building, then along Fifth Avenue to Westlake Center in Downtown Seattle.

The Seattle Center is used throughout the year for a variety of indoor and outdoor cultural and ethnic festivals and many other active uses throughout the year. Major annual festivals include the International Children's Festival, the Northwest Folklife Festival, the Bite of Seattle, and Bumbershoot. Memorial Stadium, owned and operated by the Seattle School District, provides a venue for district-wide high school athletic events and is used for concerts during several Seattle Center festivals. The Center High School, a Seattle public school, is located on the third floor of the Center House, and other floors house the Children's Museum and numerous small restaurants, retail businesses, and offices.

Recognizing the variety of functional and popular uses that occur with the Seattle Center as an urban gathering place, the Seattle Center Master Plan has identified 11 zones that are interrelated but also

recognize the unique needs for specific areas or major buildings. These include the Mercer Theatre District, the Key Arena, International Fountain Mall, Memorial Stadium, Center House, Fun Forest, EMP, Broad Street Green, Pacific Science Center, and the Fifth Avenue Parking Area. Over the last several years, a number of major improvements have been completed, improving Seattle Center campus operations and aesthetics. Notable among these are the Broad Street Green and Thomas Street Improvements, the new Marion McCaw Oliver Hall, and the new Festival Pavilion and Pavilion Lawn. In addition, the Center has completed an urban design study for the Seattle Center Theatre District, with several of its major design themes emerging in the new Marion McCaw Oliver Hall, including an emphasis on inviting access for people walking onto campus. Overall, the planning principles for the Seattle Center emphasize the values of open access, the importance of the original street grid for open space and pedestrian passageway, the connection of the campus to the surrounding neighborhoods, the integration of indoor and outdoor spaces, and effective management of transportation and parking.

The Uptown neighborhood, situated at the foot of Queen Anne Hill, is a dense, multi-use commercial center characterized by apartment houses, restaurants, retail, commercial, and office uses. The area also includes the QFC and Larry's Market supermarkets, several hotels, and churches. Queen Anne Avenue N and First Avenue N are major transit corridors, providing frequent bus service to areas including West, Upper, and North Queen Anne and Fremont. The area has high levels of pedestrian activity, particularly when events are occurring at Seattle Center. Surface parking lots are interspersed with other uses in the area, with a number of parking structures nearer to or within Seattle Center.

Belltown is situated midway between Seattle Center and Downtown and contains a variety of residential and commercial uses, including a number of clubs and restaurants. The neighborhood has a large and growing residential population and a substantial arts community. The Belltown portion of the Green Line's alignment is characterized by commercial office, retail, and multifamily residential uses.

Alternative 3.1. The Seattle Center/Republican Alternative 3.1 would enter the campus at the Key Arena and cross the Seattle Center campus along Republican Street, crossing north of the International Fountain Green and south of the Mercer Theatre District, before transitioning between Memorial Stadium and the Center House and then on to the Fun Forest and EMP zones. Nearby and adjacent uses include the Northwest Rooms immediately north of Key Arena Green Line station, the Seattle Repertory Theater, the Kobe Bell, Intiman Theater, Marion Oliver McCaw Hall, Memorial Stadium, Fun Forest, and EMP, and the Center's open spaces and green spaces.

Alternative 3.2. The Mercer Alternative 3.2 would enter at Key Arena, but then travel around Seattle Center via Warren Street to Mercer Street along the Mercer Theatre District. It would then turn to Fifth Avenue N, which is bound by the Fifth Avenue Parking zone, Memorial Stadium zone, and EMP. Specific nearby and adjacent uses along Mercer include the Seattle Repertory Theater, Intiman Theater, Marion Oliver McCaw Hall, and a diverse mix of restaurants, small shops, the Skateboard Park, and the Center's main parking areas.

Alternative 3.3. The Seattle Center/Thomas Alternative 3.3 would enter Seattle Center at Key Arena and travel through the Center along Thomas Street. The Seattle Center Master Plan zones it would cross would include the Key Arena, the Seattle Children's Theater/Mural Amphitheatre, the International Fountain Mall, the Center House, the Fun Forest, the Broad Street Green, and EMP. Specific adjacent uses include Sacred Heart Church, Seattle Children's Theater, the Festival Pavilion, and the Space Needle, as well as the Center's open spaces and green spaces.

Alternative 3.5. The Second/Denny Alternative 3.5 would enter the Seattle Center at Key Arena, crossing to the southwest, before turning to follow Second Avenue N to Denny Way, around the Pacific Science Center. Land uses along this alignment alternative are a mix of multifamily and commercial business, parking facilities, and office uses along the south side of Denny Way, and Seattle Center and the Pacific Science Center on the north side.

In Belltown, all Green Line alignment alternatives would be adjacent to an area of mixed commercial and residential uses, including movie theaters, hotels, mixed-use and apartment buildings, and a variety of retail and service uses.

Zoning along the Queen Anne/Seattle Center/Belltown Segment of the alignment is predominantly neighborhood commercial and Downtown zoning. Table 4.3-4 and Figure 4.3-3 show land use, zoning, and shoreline designations in the Queen Anne/Seattle Center/Belltown Segment.

Table 4.3-4. Queen Anne/Seattle Center/Belltown Land Use and Zoning Designations

Alignment Segment	Primary Land Use	Primary Zoning Designation
West side on W Harrison Street	Neighborhood commercial	NC3-65
Seattle Center	Neighborhood commercial	NC3-85
North side on Mercer Street	Neighborhood commercial	NC3-40
East side on Fifth Avenue N-	Neighborhood commercial	NC3-65
Fifth Avenue to Stewart Street	Neighborhood commercial, Downtown	NC3-85, DMR/C 240/125

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., NC3-40).

The Seattle Center, Queen Anne, and Belltown neighborhoods have about 5,500 people who live in the census tracts along the Green Line, of which 12 to 25 percent are minorities and six to 18 percent are below the poverty line (2000 U.S. Census). Seattle Center is dominated by entertainment uses as described above. Uptown, the portion of the Queen Anne neighborhood closest to the Green Line and Seattle Center, is a mix of residences, entertainment, restaurants, and bars. Residents and visitors are drawn to the area for its vibrant nightlife. Many Uptown/Queen Anne residents are single, young adults and seniors. The Belltown Urban Center Village is part of the Denny Regrade Urban Center. The area is economically, socially, and ethnically diverse, with a range of housing from high-end condominiums to artist's studios to homeless shelters. The Belltown neighborhood, with its many restaurants, bars, and clubs, is another area known for its nightlife. The Denny Triangle, recently full of parking lots and low-rise buildings, is rapidly being developed into a dense commercial and residential area. Pedestrian activity and transit use is high in the Seattle Center/Queen Anne/Belltown Segment.

Seattle Center/Queen Anne Station Alternatives

The area around both Seattle Center/Queen Anne station alternatives is characterized by a concentration of entertainment venues and commercial uses, with adjacent neighborhood and commercial uses, including shops and multifamily residences. In addition to Seattle Center, mid-rise apartments and condominiums, mixed commercial and residential, office, restaurant, and retail uses are located in the Key Arena area. There is a gradual transition from office uses near the intersection of W Harrison Street and Elliott Avenue W to mixed multifamily residential and commercial service uses closer to Key Arena. This pattern typifies much of the neighborhood around Seattle Center, with high concentrations of street-side retail and restaurants along the main commercial avenues such as Mercer Street and Queen Anne Avenue N. Mid- to high-density multifamily residential is the primary use east of the neighborhood's commercial core ascending the lower west slope of Queen Anne Hill. Land uses within 1/2 mile of the station area are primarily commercial and high-density residential. The Center School, a public high school, is located in the Center House of the Seattle Center. Zoning in the area of the Seattle Center is commercial, with height limits of 65 to 85 feet. Zoning of the Seattle Center itself is NC3-85. More intensive downtown zoning begins to the south of Denny Way.

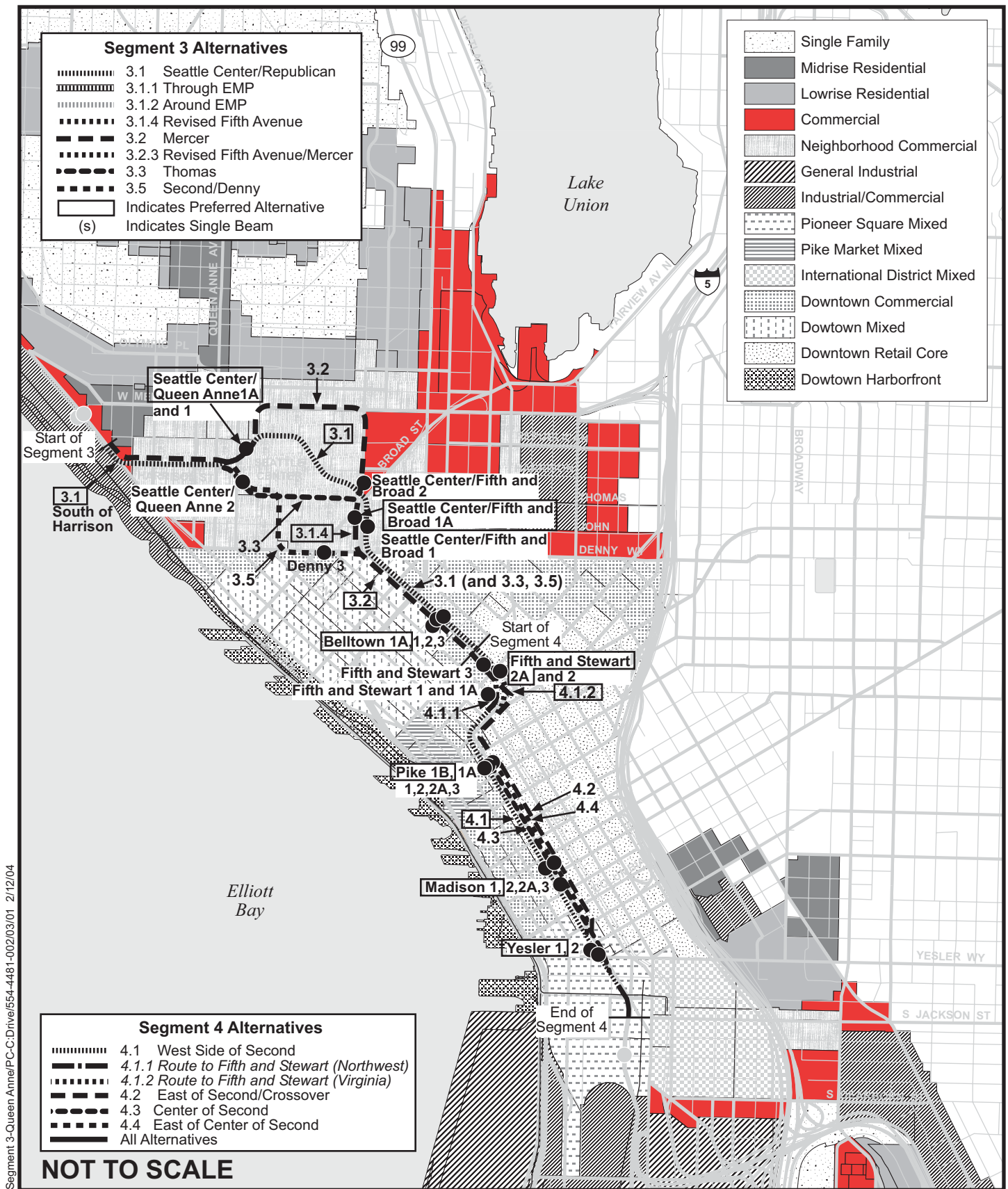


Figure 4.3-3
Segment 3 and 4: Queen Anne/
Seattle Center/Belltown,
Downtown/Pioneer Square
Land Use, Zoning, and Shoreline
Designations

Seattle Center/Fifth and Broad Station Alternatives

The area near these station alternatives is also characterized by entertainment, museum, green space, and commercial uses. The Space Needle and existing Seattle Center Monorail are located to the west of these station alternatives. Nearby businesses include a television station, the EMP, and a fast food restaurant. East of Fifth Avenue, the primary uses are offices and parking. Buildings are generally low to mid-rise in height (less than 10 stories). Land uses in the vicinity of the station area are primarily commercial and high-density residential.

Denny Station Alternative

This station would be part of the Second/Denny Alternative 3.5 alignment to the south of Seattle Center and is currently the location of a Wells Fargo Bank branch. The area is characterized by mid-rise office building, high-density residential, and commercial retail and service uses. The Pacific Science Center is located northwest of the station location, across Broad Street. Land uses within the vicinity are primarily commercial and high-density residential.

Belltown Station Alternatives

Four station alternatives are being evaluated near the intersection of Fifth Avenue and Bell Street. Belltown is the closest residential neighborhood to Downtown, with Bell Street the approximate center of the neighborhood. The Belltown neighborhood has seen extensive redevelopment over the past 10 years, with older businesses and low-rise apartment buildings being replaced with mid-rise office buildings, condominiums, and apartments. There are few buildings over 10 stories (many are only three to four stories, with less than a dozen in the 15- to 20-story category), among them several new apartment and condominium towers. The general area of the station alternatives includes a number of entertainment venues and dozens of small restaurants and specialty retail shops. Land uses within 1/2 mile of the station area are primarily commercial and high-density residential. Community resources in Belltown include Tilikum Place and Fire Station 2.

4.3.1.4 Segment 4: Downtown/Pioneer Square Segment

Downtown Segment Alignment Alternatives

Downtown Seattle is a compactly developed area supporting a diversity of uses meeting the employment, residential, shopping, service, and entertainment needs of the broadest range of the region's population. Uses along the alignment are primarily large-scale office and retail. The area includes two historic districts (Pike Place and Pioneer Square), as well as a large number of historic buildings outside of the districts. Among the uses near the alignment are the Westin Hotel, Westlake Center, Pike Place Market, Benaroya Hall, the Seattle Art Museum, the Jackson Federal Office building, Smith Tower, and Pioneer Square. All Downtown Green Line alignment alternatives are in Downtown zones, which allow for a wide range of high-density uses. Table 4.3-5 and Figure 4.3-3 show land use and zoning designations within the Downtown Segment.

Downtown Seattle is made up of several neighborhoods, or urban centers, as defined in the Downtown Urban Center Neighborhood Plan. The Green Line passes through the Commercial Core and Pioneer Square in the Downtown Segment. About 5,095 people live in the census tracts along the Green Line (2000 U.S. Census) in the Downtown Segment, of which 25 to 43 percent are minorities and 25 to 63 percent are below the poverty line. The commercial core of Downtown Seattle is a major tourist and convention attraction, retail shopping area, center of cultural and entertainment activities, and central business district. Pioneer Square, the nation's first designated Historic District, is an active arts district, hosting galleries, design and advertising firms, and residential uses and artist live/work studios. Pioneer

Square contains a number of clubs, restaurants, and outdoor cafes. The Seattle waterfront hosts restaurants, bars, the aquarium, retail, a streetcar, and the ferry terminal. High-rise and mid-rise condominiums and apartment buildings are found throughout the Downtown Segment, as well as missions and shelters serving disadvantaged people. Pedestrian activity and transit use is high in the Downtown Segment. The Downtown section of the Green Line route passes through some of the areas of Seattle zoned for the highest bulk and scale development, including 240 foot height limits along Fifth Avenue in the DMC and DMR/C zones, height limits up to 125 feet in the retail core DRC zones along Stewart Street and Second Avenue, height limits up to 240 to 450 feet in the office core's DOC and DMC zones along Second Avenue, and 100 to 120 feet in the Pioneer Square Area's PSM zones.

Table 4.3-5. Downtown/Pioneer Square Land Use and Zoning Designations

Alignment Segment	Primary Land Use	Primary Zoning Designation
Fifth and Stewart station	Downtown core	DMC-240
Pike station	Downtown core	DRC 85-150
Madison station	Downtown core	DOC 1-450/DOC2-240
Yesler station	Downtown core	PSM-100

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., DMC-240).

Fifth and Stewart Station Alternatives

The area of the Fifth and Stewart station alternatives is near Seattle's retail core. This area is characterized by small and large retail outlets, offices, hotels, and restaurants. Major businesses along or near the alignment include Westlake Center, which contains an extensive mix of retail, restaurants, and office space, the Westin Hotel, Nordstrom, Bon-Macy's, and Pacific Place. The station area is also near the Washington State Convention Center. Land uses within the vicinity of the station area are primarily office and retail. Community resources near the Fifth and Stewart station include Regencecare Health Maintenance Organization, the West Police Precinct, and Westlake Park.

Pike Station Alternatives

The Pike station alternatives are near the Pike Place Market Historic District (one block to the west). Existing uses along Second Avenue in this area include commercial business and office uses and high-rise residential uses, such as the Newmark Building. The nearby Pike Place Market is a significant year-round tourist attraction. The Seattle Art Museum and Benaroya Hall are located only a few blocks south of the station location alternatives. There is also a significant Downtown residential component in the Pike Place Market area. Land uses within the vicinity of the station area are primarily office and retail.

Madison Station Alternatives

The area of the Madison station alternatives is characterized by high-rise office buildings. The Federal Reserve Bank, a historic building, and Wells Fargo Center are located on Second Avenue across from the station location alternatives. The Jackson Federal Office Building is located on Second Avenue between Madison and Marion Streets. The Elliott Bay waterfront is a three-block walk to the west, with access to ferries, restaurants, and retail. Land uses within the vicinity of the station area are primarily office and retail, and a number of the buildings are historic resources, as discussed in Section 4.11, Cultural Resources. Another community resource near the Madison Station is Fire Station 5.

Yesler Station Alternative

The Yesler station alternative would be located between James Street and Yesler Way. This area is in the Pioneer Square Historic District, which comprises the highest concentration of historic resources in the City. There is a growing residential population in the general area, but the area near the station alternatives (at or adjacent to the “Sinking Ship” parking garage) is characterized by office and commercial/retail uses. The Smith Tower, a historic building and the City’s first high-rise office building, is across the street (see Section 4.11, Cultural Resources). The Pioneer Square entrance to the Downtown Seattle Transit Tunnel is less than a block east on Yesler Way. This station area is also near government offices, including the King County Courthouse, King County Administration Building, King County Jail, Seattle Municipal Building, and Seattle Police Department. Land uses within the vicinity of the station area are primarily office, governmental, and retail with some residential. Other community resources near the Yesler Station include Pioneer Square, Occidental Square, and Providence Health Systems.

4.3.1.5 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

SODO Segment Alignment Alternatives

Land uses within a block of all Green Line alignment alternatives in the SODO Segment generally include warehousing and distribution, light manufacturing, parking, and mid-rise offices. There are also some retail, convenience store, and restaurant uses. Major facilities in the northern portion of this segment include King Street Station, Seahawks Stadium, Stadium Exhibition Center, and Safeco Field. The King Street Station supports Amtrak and Sounder commuter rail and is located near the southern terminus of the Downtown Seattle Transit Tunnel and proposed future light rail. This area of the SODO Segment is also near Seattle’s International District. Larger facilities further south in this segment include the SODO Center (Starbucks headquarters) and the Seattle Public Schools administration building (the John Stanford Center for Educational Excellence).

Zoning along the Green Line alternative alignments in the SODO Segment includes Pioneer Square Mixed (a Downtown zone), but is predominantly Industrial/Commercial and General Industrial. Table 4.3-6 and Figure 4.3-4 show land use, zoning, and shoreline designations in the SODO Segment.

Table 4.3-6. SODO/Chinatown International District/Pioneer Square Land Use, Zoning, and Shoreline Designations

Alignment Segment	Primary Land Use	Primary Zoning/Shoreline Designation
Weller/King Street station	Downtown	PSM-85-120
Third Avenue S to Safeco Field	Manufacturing/industrial	IC-65
Safeco Field station	Manufacturing/industrial	IG1 U/85
Lander station	Manufacturing/industrial	IG2 U/85
Crossing to West Seattle Bridge	Manufacturing/industrial	IG1 U/85
Duwamish/Harbor Island	Manufacturing/industrial	IG1 U/85, UI shoreline

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., IC-65 and IG2 U/85).

The SODO Segment is primarily located in the Duwamish Manufacturing and Industrial Center. In addition the northernmost part of the SODO Segment is located in the Pioneer Square Historic District and adjacent to the Chinatown-International District Urban Center village. Two professional sports stadiums are in SODO. About 2,553 people live in the census tracts along the Green Line in SODO, of which 39 percent are minorities and 13 to 49 percent are below the poverty line (2000 U.S. Census). The

Chinatown International District urban center village, one of Seattle's oldest neighborhoods, is known as a regional hub for Asian-Pacific American commerce and culture. The community is characterized by a sizable elderly population and a large number of affordable housing units and low-income households. The area is home to many small businesses, social services, and community development organizations. Pedestrian activity is high in the International District and stadium areas.

The policies of the Duwamish Manufacturing and Industrial Center Plan encourage protection of industrial land from the pressure of encroaching residential and retail uses. The Duwamish Manufacturing and Industrial Center is an international trade and transportation crossroads, receiving and distributing goods via roadway, water, rail, and air. It is home to the Port of Seattle's primary shipping operations, the main Amtrak and freight rail yards for Washington State, and the intersection of major interstate highway routes (City of Seattle 2003).

Weller/King Street Station Alternatives

These station alternatives are near the existing King Street Station and the Weller Street Pedestrian Bridge, which provides access to the retail, restaurant, office, and residential uses of the Chinatown International District urban village. The area is part of Pioneer Square. It is also adjacent to a major spectator sports facility—the Seattle Seahawks Stadium with its nearby Stadium Exhibition Center. King Street Station, directly north, serves Sounder commuter rail and Amtrak. A pedestrian bridge at Weller Street provides access from the commuter rail platform to the International District station of the Downtown Seattle Transit Tunnel to the east. The overall area is an active transportation hub, providing links to surface bus, commuter rail, regional rail, and future light rail. Other community resources include Union Station Square, Fortson Square, Washington Square, and Fire Station 10. Land uses within 1/4 mile of the station area are a mix of transportation, spectator sports stadium, exhibition center, office, commercial, manufacturing and residential. Zoning in the area is Pioneer Square Mixed with the Chinatown International District urban village to the east and industrial-commercial zoning in the Stadium Overlay District to the south. Zoning throughout the remainder of the SODO Segment in the areas of the Green Line and stations is industrial (IG1 and IG2). Residential properties in the area include a substantial inventory of affordable housing units as well as market rate properties, primarily multifamily developments; these occur in the Chinatown International District as well as in Pioneer Square.

Safeco Field Station Alternative

The area near this station alternative is characterized by Safeco Field, the BNSF railroad, and the intersection of S Royal Brougham Way and Fourth Avenue S. Office, warehousing and distribution uses are located in surrounding blocks to the south and east. The Safeco Field station could provide primary access to Safeco Field but could also serve the Stadium Exhibition Center and Seahawks Stadium. The Ryerson and Atlantic/Central Metro Bases are located across Fourth Avenue S, east of the station area. The neighborhood is characterized by extensive truck and rail traffic. A Port of Seattle container terminal is located less than 1/2 mile southeast of the station area and is home to a large container shipping operation. Land uses within the vicinity of the station are a mix of commercial and industrial. The Washington State Department of Transportation (WSDOT) is currently constructing a new on-ramp to eastbound I-90 at S Atlantic Street near the proposed Green Line station.

Lander Station Alternatives and SODO Operations Center Alternative

The area of all the Lander station alternatives is generally characterized by low-rise manufacturing, distribution, and office uses. Major employment uses near the station alternatives are the Seattle Public Schools offices (the John Stanford Center) and the SODO Center (Starbucks corporate headquarters and

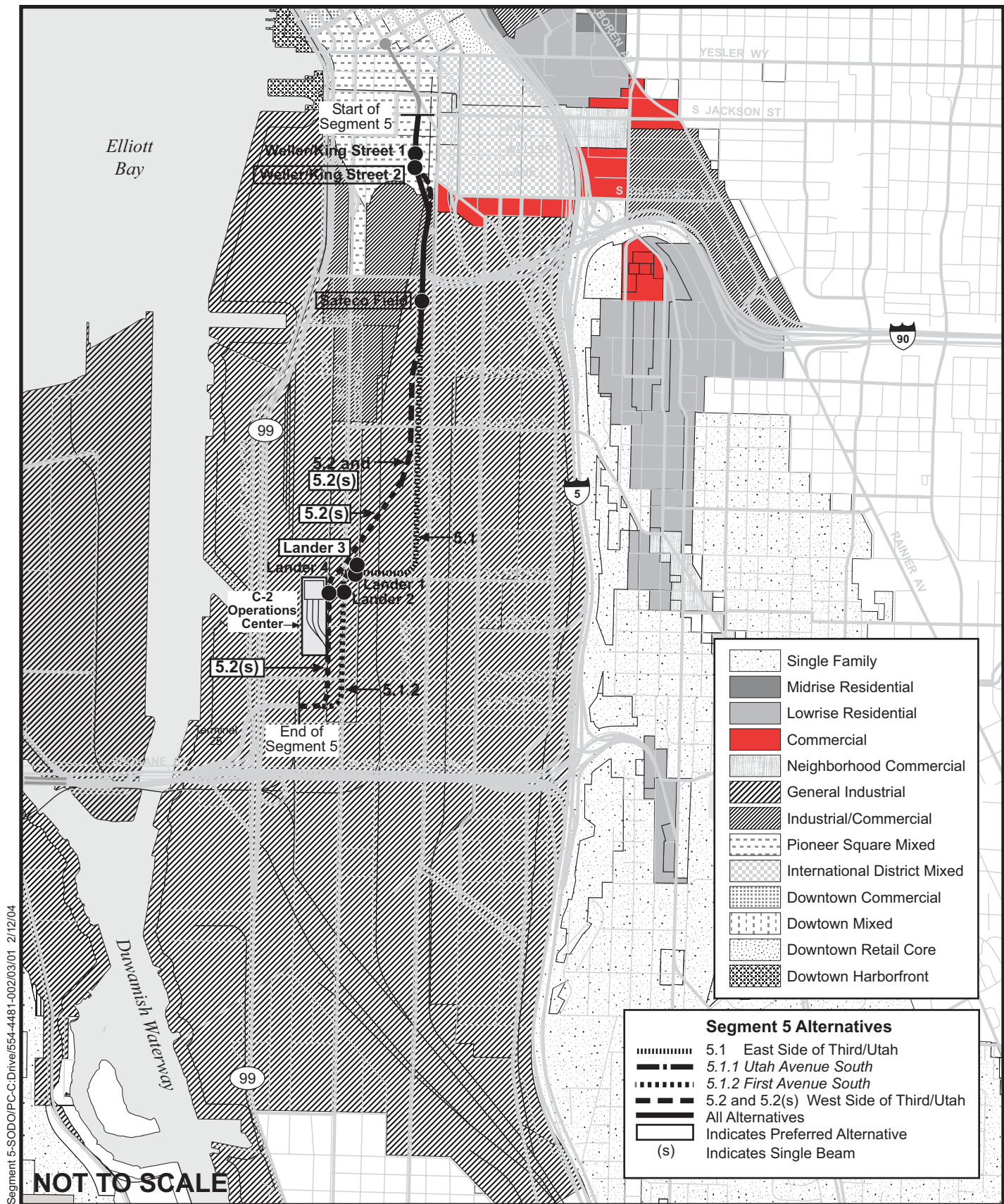


Figure 4.3-4
Segment 5: SODO/Chinatown
International District/Pioneer Square
Land Use, Zoning, and
Shoreline Designations

other offices). Other major uses in the general area include Rabanco Recycling, Inc. and Pacific Iron and Metal Fabrication, which is located a block east of the Green Line south Operations Center alternative (at the southwest corner of S Lander Street and Utah Avenue S). As with the other SODO station areas, frequent truck traffic characterizes the area. Land uses within the vicinity of the station are a mix of commercial and industrial. As part of the Sound Transit Central Link light rail project, a light rail station is also planned on S Lander Street and is proposed to be located several blocks to the east of the proposed Green Line station.

The SODO Operations Center alternative (C-2) is located at the corner of Utah Avenue S and S Lander Street on a site currently used for household retail (Home Depot). The area of this alternative site is characterized by commercial and warehousing uses and retail stores (primarily along First Avenue S), with SR 99/Alaskan Way Viaduct, rail facilities, and Port of Seattle-owned container shipping terminals to the west.

4.3.1.6 Segment 6: West Seattle Segment

West Seattle Segment Alignment Alternatives

The guideway alignment for either Green Line alternative in West Seattle would pass over the Duwamish Waterway manufacturing area. A mix of heavy manufacturing (Nucor Steel), restaurants and other neighborhood commercial retail and office uses, and multifamily residential uses characterizes the area between the West Seattle Bridge and SW Avalon Way. Moving along SW Avalon Way from north to south from the West Seattle Bridge, the area transitions from the large scale Nucor property and the Port of Seattle property to the north, to adjacent storage facilities, to restaurant and commercial uses and mid-rise residential uses. Single family homes begin within one to two blocks to the west. Two of the alternatives would travel adjacent to the West Seattle Golf Course and West Seattle Stadium Park (which is owned and operated by the Seattle Parks Department), as discussed in Section 4.10, Parks and Recreation. This includes Alternative 6.5, Genesee, which would include a section along the south side of SW Genesee Street, beside the West Seattle Golf Course, before turning south along 35th Avenue SW. SW Genesee Street in this area is characterized by the tree-lined park property to the south, and single family dwellings to the north.

The areas along Fauntleroy Way SW, SW Alaska Street, and California Avenue SW along which alignment alternatives would travel are characterized by commercial, multifamily, and office uses. California Avenue SW is the primary north/south route in West Seattle, with commercial and multifamily residential uses predominating along the street, with single family residences on the blocks to the east and west of SW California Street. -The Alaska Junction area (called the West Seattle Junction in the Seattle Comprehensive Plan) is characterized by commercial, retail, and office uses, with nearby multifamily residential and single-family residential areas. The area along California Avenue SW between the Alaska and Morgan Junctions is characterized by mixed use (commercial/multifamily residential), small retail and service commercial uses, and multifamily residential uses, with single family residential areas within one block. The Morgan Junction area is characterized by commercial retail and service uses, with some larger multifamily structures near California Avenue SW.

Zoning along the alignment varies from General Industrial, Mid-Rise Residential, and Industrial Buffer, to Neighborhood Commercial. Table 4.3-7 and Figure 4.3-5 show land use and zoning designations within the West Seattle Segment.

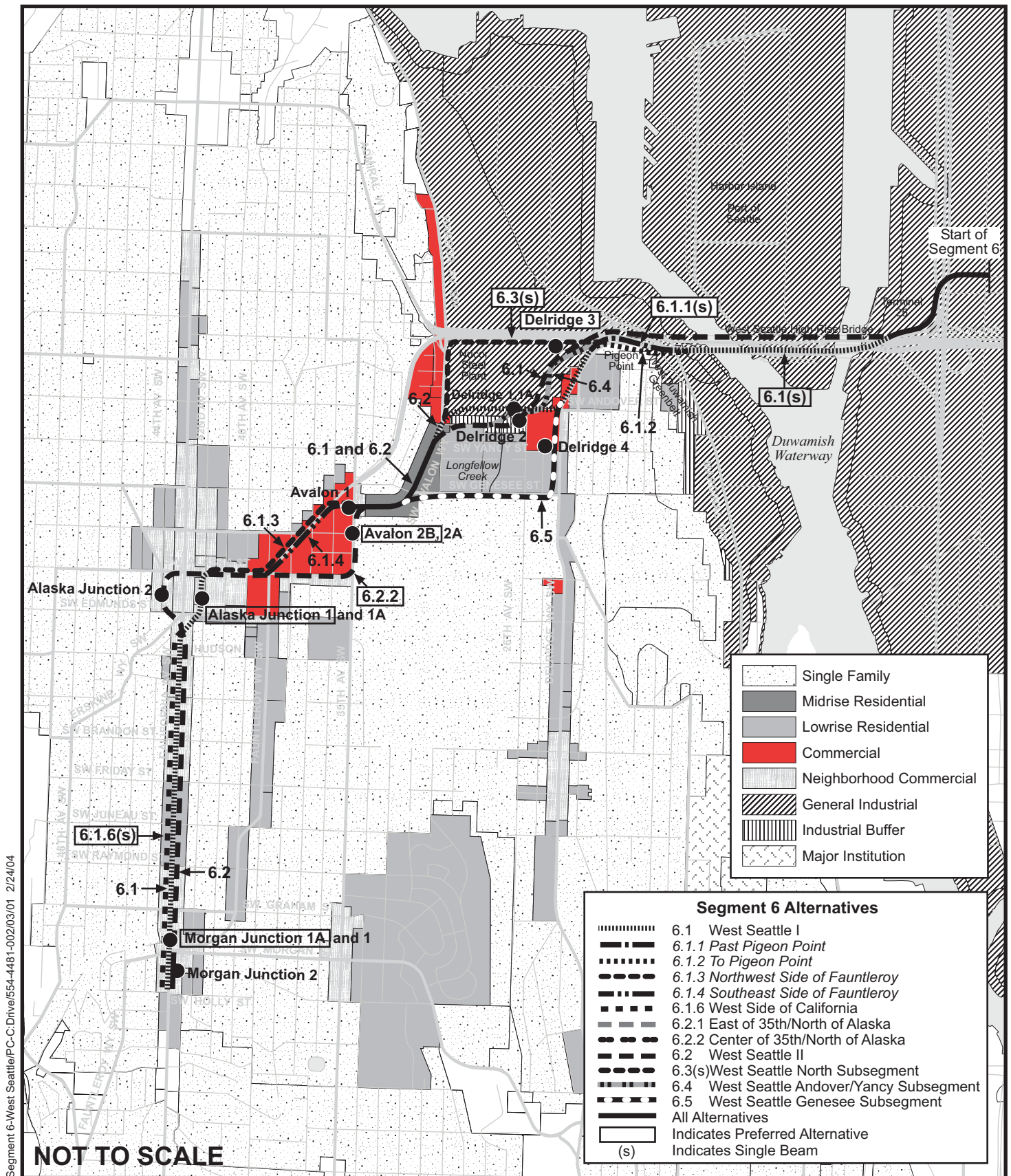


Figure 4.3-5
Segment 6: West Seattle
Land Use, Zoning, and Shoreline
Designations

Table 4.3-7. West Seattle Land Use and Zoning Designations

Alignment Segment	Primary Land Use	Primary Zoning Designation
Delridge station	Residential, manufacturing/industrial	IG2, IB U/85
Southwest corner of steel plant	Manufacturing/industrial	IG2, C1-65, C1-40
Climb to Avalon station	Multifamily	MR
Avalon station	Neighborhood business/park land	NC3-65, C1-65
Alaska Junction	Neighborhood business	NC3-65, NC3-85, NC2-65
California Avenue SW to SW Morgan Street	Neighborhood commercial, multifamily	NC2-65, NC2-30, L3/RC, NC2-30
Morgan Junction	Neighborhood commercial	NC3-30

Note: Numerical suffixes to zoning designations indicate building height limits within the zone (e.g., NC3-30 and IB U/85).

The West Seattle neighborhood is Seattle's largest neighborhood and is made up of several smaller, primarily residential, neighborhoods. The Delridge Neighborhood, West Seattle (Alaska) Junction Urban Village, and Morgan Junction Residential Urban Village are West Seattle neighborhoods that the Green Line passes through. Although pedestrian activity occurs around the neighborhood commercial centers, most residents rely on automobiles and transit. About 13,760 people live in the census tracts along the Green Line (2000 U.S. Census) in West Seattle, of which 10 to 36 percent are minorities and 4 to 16 percent are below the poverty line.

Delridge Station Alternatives

The area immediately adjacent to the Delridge station alternatives includes heavy industrial, office, and retail service uses. Most of the station alternatives would also be near Longfellow Creek, in an area which includes green space and is the subject of a number of ongoing planning programs related to habitat restoration. Nearby uses include multifamily and mixed use with residential. The largest nearby industrial use is the Nucor Steel plant, which occupies a 44-acre site. The Port of Seattle-owned container shipping terminals and industrial area and the Duwamish Waterway are also significant features immediately north of the West Seattle Bridge. The Seattle Commerce Center occupies a site east of the Nucor plant. Three of the alternative station locations would occupy a site operated as a parking lot by the Services Group of America office building across 26th Avenue SW to the east or utilizing a vacant lot to the west. Low-rise residential uses and the Longfellow Creek green space are located further to the south. Land uses within 1/4 mile of the station area include industrial and manufacturing, neighborhood commercial, and multifamily residential. Community resources near the Delridge Station include Delridge Community Center, Fire Station 36, West Duwamish Greenbelt, and Longfellow Creek Greenspace. Alternative 6.3(s), Delridge North Single Beam, would place the station on the northern boundary of the Nucor steel plant property, which is industrially zoned. Alternative 6.5, Genesee, which would include a longer initial section along the western side of Delridge Way SW before turning east to the south side of SW Genesee Street, beside the West Seattle Golf Course and Stadium park, would place a Delridge station to the west of Delridge Way SW, on a commercially zoned property, in an area that within the next block transitions to smaller parcels, including residential properties to the south.

Avalon Station Alternatives

The area of the Avalon station alternatives consists primarily of automotive sales and service, retail commercial, multifamily, and recreational uses. Uses immediately adjacent to the Avalon 1 station alternative include Alki Lumber and several convenience food outlets. Immediate uses adjacent to the Avalon 2 station alternative include multifamily residential and the West Seattle Golf Course and West

Seattle Stadium Park. Land uses within the vicinity include residential, commercial, and park/recreational. Community resources near the Avalon station include West Seattle Stadium Park, Fauntleroy Place, Fire Station 32, and West Seattle Montessori School. Zoning in the area is predominantly commercial, with C1-65 zoning along Fauntleroy and north of 35th Avenue SW, and NC3-65 zoning at the intersection of SW Avalon Way/35th Avenue SW. The West Seattle Stadium Park is zoned single family and utilized for park purposes.

Alaska Junction Station Alternatives

The areas of both Alaska Junction station alternatives are characterized by commercial land uses, with nearby multifamily uses. The Alaska Junction area has the highest concentration of commercial land uses in West Seattle. Commercial and multifamily uses predominate around the Junction, with a gradual transition to high- and medium-density residential. Jefferson Square is located directly west, across the street from the Alaska Junction 1 (42nd/Edmunds) station alternative and includes a mix of multifamily residential, office, and retail. There is a surface parking area adjacent to the Alaska Junction 2 (44th/California) station alternative that provides parking for businesses along California Avenue SW and also provides space for a farmers' market during spring, summer, and fall. The six-story Junction Tower building is located at the south end of the parking lot. A 10- to 11-story senior apartment building is located on the northwest corner of SW Alaska Street and 42nd Avenue SW. Retail uses along California Avenue SW between SW Alaska Street and SW Edmunds Street include Petco, NW Art and Frame, Curious Kidstuff, Husky Deli, Key Bank, and Urban Fitness. South of the Alaska Junction area, mixed-use buildings and mid-rise apartments line both sides of California Avenue SW for two to three blocks. The general area within the vicinity of the station site is characterized by a high concentration of multifamily residential and commercial uses. Community resources near the Alaska Junction Station include Hope Lutheran School, Seattle Lutheran High School, Pathfinder School, and West Seattle Christian School. Zoning in the area is predominantly NC3-85 and NC3-65.

Morgan Junction Station Alternatives

The area of the Morgan Junction station alternatives is characterized by commercial land uses. Morgan Junction is also the closest station area to the Fauntleroy Ferry dock, which provides service to Vashon Island and Southworth, and which is located approximately two miles to the southwest. A Thriftway grocery store serves as the anchor business in the area, but there are numerous neighborhood commercial sales, service, and retail uses. Representative uses include mid-rise apartment buildings, branch banks, video rental outlets, coffee shops, and a bicycle shop. A video outlet and neighborhood auto repair shop occupy the site of the Morgan Junction 1 (West) station alternative, which would be located between SW Eddy Street and SW Beveridge Place. The Morgan Junction 2 (Center) station alternative would be located primarily in the street right-of-way with a small station area on the southwest corner of California Avenue SW and SW Fauntleroy. The area to the north and south along California Avenue SW is characterized by multifamily residential with some retail. Uses further to the east and west are generally single-family residential. Areas within the vicinity of the station area are generally residential and neighborhood commercial. Community resources near the Morgan Junction Station include Eddy Street Ravine, Fairmount Park Elementary, and Gateway Elementary. Zoning in the Morgan Junction area is NC3-30, with low-rise residential areas (L3) to the east and single-family residential zones downhill to the west.

4.3.2 Impacts

4.3.2.1 Long-Term Impacts of the Green Line

Overview of Common Impacts

Using impact areas identified in State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA) guidance and considering comments during scoping, the analysts examined the project for its potential to, among others:

- Relocate private residences.
- Relocate businesses.
- Impact parks, community services or community centers, or significant cultural features.
- Remove property or other built environment features integral to the use of surrounding properties.
- Impact traffic patterns or increase traffic volumes.
- Reduce parking supply or increase demand.
- Require the rerouting, removal or reduction of transportation systems or services, including general vehicular, bicycle, pedestrian, and transit.
- Create bottlenecks for vehicle (or vessel) traffic.
- Create access constraints.
- Affect a congested intersection.
- Increase or decrease population or density.
- Introduce development or activities incompatible with existing uses.
- Create conflicts with, preclude, or discourage adopted plans or goals.
- Create noise or vibration impacts.
- Be inconsistent with the planned or preferred land use for the area.
- Increase infrastructure demands (e.g., sewer, water, utilities, street system, public transit).
- Increase support facilities demands (e.g., schools, hospitals, police, fire, shopping facilities, and recreation facilities).
- Reduce safety or environmental health.

Other sections of this EIS specifically address many of the issues listed above. In particular, housing is discussed in Section 4.2, Displacements and Relocation; light, glare, and aesthetics are discussed in Section 4.5, Visual Quality and Aesthetic Resources; and historic/cultural preservation is discussed in Section 4.22, Cultural Resources. Based on those analyses, many of the Green Line alternatives would involve a limited set of potentially negative effects that, without reasonable mitigation, could individually or collectively cause impacts to neighborhoods. The most common impacts include individual property acquisitions; access, traffic, and parking impacts; and noise impacts. The analysis also considers cultural/historic impacts, as well as visual and scale issues related to the stations and the guideway, but unless these impacts were of a high magnitude, they were not found likely to cause impacts to land use plans or neighborhoods, given the projected transportation and related benefits provided by the Green Line.

Potential property acquisitions for the Green Line are limited in number and do not affect continuous areas of the alignment. In most locations, property acquisitions would affect one to three properties, mostly to provide stations, and generally would not be of a scale that would alter current or future development patterns. Long-term impacts to public services, parks and recreation, economics, air quality, and environmental health are also limited. The aerial nature of the Green Line guideway would not physically isolate one neighborhood function from other important functions and would not prevent affected neighborhoods from continuing to interact effectively as coherent communities. The Green Line would not directly cause new development. The majority of proposed station areas lie within densely developed residential or commercial areas that are already targeted for moderate (urban villages such as in Ballard or West Seattle) to high rates of growth (urban centers such as Seattle Center/Queen Anne or Downtown) in regional plans. Significant population changes due to the presence of the Green Line are not anticipated to occur with any of the alignment or station alternatives, and displacements of housing are limited. Greater mobility along the Green Line, however, could facilitate projected future growth in the urban centers and urban village areas consistent with existing zoning and adopted plans.

As discussed in SMP's urban design program commitments (Appendix MM) the project also incorporates measures available to improve transitions between the Green Line facilities and adjacent zoning areas. Such measures include façade modulation, varied color and finish material of facades, variation in structures and elements of the station area facilities, transparency in station design, choosing station siting options that blend best with the character of the neighborhood's planned development, landscaping, screening, and other techniques to offset the appearance of incompatible height, bulk and scale.

Although impacts to land use are examined in terms of contrasts to development allowed under existing zoning, because of the unique nature of the Green Line's elevated structure, and the requirements that stations and guideways should have sufficient clearance from street traffic on the rights-of-way below, some monorail facilities may require waivers in zoning height or setbacks in some locations, which in itself would not necessarily create a significant impact with appropriate design. The Green Line is also unique in being an essential public facility.

A number of comments to the Draft EIS asked for additional information regarding the monorail train's "dynamic envelope" and what that would mean for potential repairs and maintenance of buildings along the Green Line route. The train's dynamic envelope is the furthest area in which the monorail train would ever be located even under worst case conditions. Under normal operating conditions, the monorail train would travel along its normal "static envelope" or normal operating envelope. Under extreme conditions, however, the train could vary from this normal operating condition and be located closer to the property line and building façade. This limit on where the train would ever be located along the guideway, even under the most extreme conditions, is called the "dynamic envelope." The minimum, specified distance from the dynamic envelope to property lines or building facades would be five feet under current specifications, which have been recommended by the Fire and Life Safety Committee (composed of SMP systems and facilities engineers and experts from Washington Department of Transportation and the City of Seattle Fire, Police, Transportation, DPD, and other departments) as a design minimum clearance. This would occur in the 12 to 14-foot area along which the monorail train would pass the building, not for the entire building height.

All buildings along the line would still be able to wash windows and maintain their buildings. All common window washing equipment would be able to operate within the five-foot distance, including ladder work (under 30 feet), rope harnesses, or buckets. For more involved maintenance, such as tuck pointing older brick buildings, typical scaffolding systems are only three to four feet wide and many common scaffolding systems are even narrower. Even with a small space between the scaffolding and the building, it is easily feasible to work within the area of five feet from the building. A recent example of this is the Fisher Building, which was constructed adjacent to the existing Seattle Center monorail at the southwest corner of Fifth Avenue N and N John Street. That building was constructed even closer to the

dynamic envelope of the existing monorail trains than the minimum distances proposed from building facades to the Green Line monorail trains. The building was successfully constructed, and is currently being successfully cleaned and maintained. A letter from Fisher Media Services Company, attesting to this, is included in Appendix MM.

Commenters also wanted to know how far from buildings that static envelope, or normal operating location, would be located. This would depend on the train manufacturer selected because the taller and wider trains have greater differences between their static envelope to their dynamic envelope. Generally, however, the minimum distance to a train would be six to six and one-half feet from the property line or façade. Readers should note that, for a given column location, it is possible to move guidebeams slightly further from buildings by offsetting the guidebeams with respect to the foundation beams. The tradeoff for offset guidebeams (also called eccentric columns) is larger foundation beams in the sidewalk or right-of-way. Another method to locate trains further from buildings could be by using the single beam configuration, which is SMP's Preferred Alternative in the lower-scale areas of Ballard and along California Avenue SW in West Seattle.

A concern was also raised by some commenters about passengers reaching out of monorail windows to buildings or workers on buildings. The windows on monorail trains will either not open or will push out slightly at the top. The design specifications will not allow people to stick their arms outside the trains.

Segment 1: Ballard Segment

The Green Line alternative alignments would extend from the Crown Hill station to the Ship Canal. The potential for long-term impacts associated with Alternative 1.1 or 1.1(s) (West Side of 15th) and Alternative 1.2 (Center of 15th) are anticipated to be similar and low to moderate, and are primarily related to full property acquisitions and the modifications to 15th Avenue NW for the Green Line, and parking impacts.

Alternative 1.1 or 1.1(s) (West Side of 15th). Overall acquisitions for this alternative, which features a guideway on the west side of the street (potentially in a single beam configuration) and stations on properties to the west, would affect several parcels in each station area. No residences would be displaced with Alternative 1.1(s), but up to seven properties could be acquired and nine businesses displaced. Alternative 1.1(s) could eliminate on-street parking spaces, but the impact to businesses or residences is not expected to be substantial given available supply and low to moderate utilization (see Section 4.1, Transportation). The alternative would have the potential for hide-and-ride parking impacts in station areas, which could reduce parking availability if parking remained unrestricted. Residential parking zones are expected to be implemented by SMP in cooperation with the City of Seattle to control these types of impacts at station areas at Crown Hill and 65th Avenue NW. Please see more details about mitigation in Chapter 5. The guideway or columns could also reduce visibility to businesses on the west side of the street, but this is not expected to impair the use of the properties. In addition, modifications to the alignment following the Draft EIS have increased the distance between the Green Line guideways and adjacent buildings, which reduces the impact. Without mitigation, Alternative 1.1(s) would cause noise impacts to some residences south of 80th Street NW and within two blocks of the alignment alternatives (see Section 4.7, Noise and Vibration). The majority of residences in this area lie to the west and north of NW Market Street, including within one-half block of 15th Avenue W.

The guideways and switches or crossover tracks would be generally at or lower than zoning heights allowed for new buildings and would not be expected to result in a substantial change in the height of development. The single-beam option would reduce the bulk of some guideway sections between stations, but would require more switches near station areas, including north and south of the NW 65th Street station and north and south of the NW Market Street station. These switches would increase the bulk of the overhead sections, compared to dual beam guideways alone. Dual beams would exist at the

stations themselves in order for trains to pass one another, regardless of whether the single beam option is utilized.

With Alternative 1.1/(s), the Green Line would cross the Ship Canal west of the Ballard Bridge via a new monorail-only bridge (Alternatives 1.1.1 and 1.1.2). This new bridge would be designed to accommodate the reasonable needs of navigation and marine uses. While there could be air rights acquisitions and limited business displacements, including of a boat repair shop, no significant impact to existing land uses or planned land use is anticipated, given the increasing height of the bridge and the lack of direct conflicts with the overall industrial/maritime uses within the area. Differences in long-term impacts among the bridge design alternatives (i.e., box girder, arch, and cable-stayed, as well as the single-beam option) are primarily aesthetic and are evaluated in Section 4.5, Visual Quality and Aesthetic Resources. Potential impacts of the bridge's approach to the south of the Ship Canal are discussed with the Interbay Segment.

Displacements for the individual stations for Alternatives 1.1 and 1.1(s) are detailed in Section 4.2, Displacements and Relocation. None of the acquisitions or displacements would be considered to have an adverse effect on overall existing land use patterns or future land use plans in the areas. The NW Market 1 (SW) station would be sited in the existing parking lot of a chain drugstore/pharmacy, and this partial acquisition could substantially reduce the store's parking supply. SMP believes the business would remain viable with this partial acquisition, given the benefit of the station; the development of the station does not require demolition of the building. The NW Market 3 (Northwest) station option would avoid the potential parking impact, but would instead displace a restaurant. With NW Market 3A, the area of property required for the station would be increased to allow construction staging to be better consolidated, and the additional displacements would include an apartment building, a parking lot, and retail uses, including properties fronting NW Market Street, and a higher degree of change would be expected in this area compared to other alternatives. However, it is also possible that property utilized for construction staging could later be made available for redevelopment, consistent with zoning for the area.

The Crown Hill 1 (West) station at NW 85th Street would be located in the Crown Hill residential urban village. Both the vertically arranged station (Crown Hill 1) and the center-of-street station (Crown Hill 2) would likely be over 55 feet in height or more, with rooftop equipment extending to a maximum of 65 feet. This would be greater in height than the applicable NC3-40 zoning district and potentially out of scale with the surrounding uses. The Crown Hill 1 station would also be adjacent to single family zone (35-foot height limit at peaked roof). The Preferred Alternative (Crown Hill 1A) terminus-style station will ameliorate most of these height/scale impacts because it would eliminate a platform level, making the top of roof of the station between 40 to 45 feet, which would be more compatible with existing zoning. Existing zoning contemplates buildings in the NC3-40 zone of 40 feet with exceptions for parapets (four feet) and exceptions for rooftop mechanical (10 feet additional height for 15 to 20 percent of the roof area). Other height/bulk/scale impacts can be mitigated by design solutions such as upper-level setbacks from residentially-zoned areas, landscaping and modulation to break up bulk, breaking up massing into smaller design units, building transparency on upper levels, and other design techniques. Design treatment can mitigate bulk/scale/height impacts similar to administrative design review throughout Seattle. The station buildings and the platform length would be only slightly larger than most existing platted parcels on the west side of the 15th Avenue NW, and there are much larger parcels and uses immediately across 15th Avenue NW to the east. For the single family residential zones to the west, starting on 16th Avenue NW, the height, bulk and scale of Crown Hill 1 (West) would have more potential to contrast with the single family residential developments to the west than the other alternatives, and the Crown Hill 1A station would have the least impact and would be similar to those that could occur with existing zoning along 15th Avenue NW. Overall, given the available measures to minimize the contrasts through design approaches as described above, the impacts should not be significant.

As discussed in Section 4.4, Economics, the increased activity and mobility in station areas could also improve conditions for nearby businesses. The NW 65th 1 (West) station location would be on the southwest corner of the intersection and in the Ballard hub urban village, near the Ballard High School and Ballard Swimming Pool. A NW 65th 1A (West) station alternative has been developed to realign the station structure and guideway approaches, reducing the extent of the building and structures over 15th Avenue NW at the NW 65th Street intersection. The preferred alternative station (NW 65th 1B) side platform option would also reduce impacts to the intersection. The Preferred Alternative would allow for a single beam configuration in the Ballard area, thus lessening bulk and scale of the guideway compared to dual beam configurations options, although switches would be required to the north and south of the station, increasing the degree of visual change that would occur within station areas. With any of these alternatives, the height of the NW 65th Street station alternatives would be approximately 55 feet with elevator/mechanical penthouses up to 65 feet. This would contrast with the adjacent LDT duplex/triplex zone to the west, which allows a maximum height at peaked roof of 35 feet. Appropriate design could deemphasize the appearance of bulk and scale, and reduce contrast with nearby developments.

The NW Market 1 (Southwest) and NW Market 3 and 3A (Northwest) stations are located at the intersection of 15th Avenue NW and NW Market Street, already a significant neighborhood commercial business district, with two large retail businesses on the east and west sides of the streets, and a restaurant on the northwest corner. The presence of a monorail station and the related station area activity within each of these areas would not be incompatible with existing or planned mixed uses. The height, bulk and scale of the NW Market Street options would be within the levels allowed by zoning and would be similar to the height, bulk and scale for developments planned for this area and allowed under current zoning. The NW Market 2 (Center) station alternative would have greater impacts than other alternatives because of the structures needed to span the width of the street for this center-of-street station alternative. The Preferred Alternative station (NW Market 3A) would allow for a single beam configuration in the area between NW Market Street and NW 65th Street, thus lessening guideway bulk and scale impacts within that block compared to dual beam alternatives, although the switch to the north of the station would extend the area with additional structures with bulk above the street. As noted above, the larger area required for development of NW Market 3A could also accommodate construction staging, and although more properties would be required compared to station alternatives, and areas used for construction staging could be made available for redevelopment.

For Alternative 1.1(s), no public service facility or major community resources would be removed or adversely affected. The overall property acquisitions and related displacements of residents, businesses, or employees are relatively small in number and not concentrated. The development of the monorail stations and facilities would not create a barrier to existing movements or interaction, particularly since 15th Avenue NW is already a major transportation route. However, the noise impacts mentioned above and the potential for hide-and-ride impacts, if unmitigated, could adversely affect some nearby residences, but would not significantly alter community character. The project would also benefit the surrounding neighborhoods, particularly near station areas. Mobility for many Ballard residents would be enhanced with the Green Line, which would improve reliability, travel times, and service levels for transit riders, and provide improved connections to the regional jobs center in Downtown Seattle. Frequent and accessible monorail service could also increase interaction between the existing neighborhood business areas along 15th Avenue NW and NW Market Street. Alternatives would provide improved access to existing community features such as the Ballard Swimming Pool and Ballard High School, as well as to community facilities and other transit systems beyond the Ballard Segment. As noted in Section 4.9, Public Services and Utilities, emergency response times with Alternative 1.2 could increase slightly in some locations due to the elimination of the center turn lane on 15th Avenue NW.

Alternative 1.2 (Center of 15th). Fewer full property acquisitions and related business displacements would be necessary with Alternative 1.2. Alternative 1.2 would, however, remove more parking spaces and eliminate the center turn lane, restricting access to right-turn in and right-turn out movements, and

overall transportation conditions would slightly worsen compared to Alternative 1.1 or No Action (see Section 4.1, Transportation). The hide-and-ride impacts in station areas would be similar to Alternative 1.1/(s) and could be similarly mitigated with restricted parking zones. With the Green Line guideway in the middle of the street, west side businesses could remain more visible to potential customers, although in station areas, views of businesses up the street could be limited. Noise impacts would be similar to those described for Alternative 1.1/(s), affecting residential blocks south of NW 80th Street, although the refined noise analysis in this Final EIS shows those impacts would be less than forecast in the Draft EIS.

Segment 2: Interbay/Magnolia Segment

The primary differences between the alternatives in this segment relate to the alignment of the Ballard Crossing and the effects of its right-of-way needs on the warehousing and industrial uses on the south side of the Ship Canal. To a lesser degree, the location of stations also differentiates the alternatives. There are also potential impacts to an employer on the site of the C-1 Interbay Operations Center. Although there are slight differences in transportation conditions and parking loss, depending on the location of the guideways along 15th Avenue W and Elliott Avenue W, Section 4.1, Transportation, concluded that the impacts were not significant. This included the access restrictions that would occur with a center-of-street alignment, and potential losses of some on-street parking. As with other segments, hide-and-ride impacts could reduce the availability of unrestricted parking. Overall, the existing transportation-intensive character and predominantly industrial and lower-density commercial uses in the area create a lower potential for significant land use plan or neighborhood impacts.

Alternative 2.1 or 2.1(s) (West Side of 15th/Center of Elliott). The connections from the new Ballard Crossing would cross over warehousing and light industrial uses near the W Emerson Street overpass to the Dravus station. Depending on the exact placement of columns and vertical clearances, Alternatives 2.1.1 (West Bridge Connection) and 2.1.2 (Far West Bridge Connection) could both displace business uses that lease space within the Port of Seattle Fishermen's Terminal facility. Options for a single beam crossing of the Ship Canal could reduce the size of columns and special structures, comparatively reducing the bulk of the facility in this area, but no substantial difference in effects would be involved. Specific business activities that could be displaced are the following:

- West Bridge Connection (2.1.1)—two marine railways serving a shipyard at Fishing Vessel Owners building could be affected by pier placement.
- Far West Bridge Connection (2.1.2)—Dock 4, the western portion of Seattle Ship Supply, the Iate building, and two net shed buildings could be affected depending on column placement.

Both of the west bridge connections to Interbay would cross above active industrial marine facilities. Alternative 2.1.1's bridge piers would likely affect the operations of one ship repair business. However, a slight realignment of the bridge piers could allow that marine business to retain its marine railway/boat haul-out facilities, which would prevent the need to relocate those uses. Impacts to the business could be minimized by temporary relocation assistance. The ship repair operation could be difficult to relocate in the nearby area because of limited suitable sites with water access. During construction, there is likely to be an interruption of the shipyard's business, which could result in the need for a temporary displacement. Even in the worst case, if the business required relocation, the larger pattern of industrial maritime uses in the Interbay area would not be significantly affected. The impacts of Alternative 2.1.2 (Far West Bridge) to Dock 4 could reduce some moorage for fishing vessels and could also have impacts of some turning movements in the Port facility, depending on column location.

The Dravus 1 (16th) station and potential bus layover facility on the current QFC grocery store site would be a vertical station. The required height of this station would be approximately 55 feet and elevator overruns could be approximately 65 feet. This would contrast with the planned 40-foot height limit in immediately surrounding C1-40 zones (which allows 40-foot height limits with 15 feet of additional

height for rooftop mechanical equipment). This would not contrast with the nearby IG2 zoned areas, which have no height limit for most uses. Displacement of the grocery store by the Dravus 1 station could involve neighborhood impacts because it is one of the few grocery stores within the Interbay and northeast Queen Anne areas, and it is the closest to the multifamily and single-family residences on Queen Anne immediately to the east of 15th Avenue W and on the eastern slope of Magnolia. These areas were identified in the 2000 census as having relatively high populations of low-income households. However, the presence of the station would also improve mobility and areawide access for neighborhood residents, and the presence of a station in the W Dravus Street neighborhood could improve and support the long-term vitality and economic activity of the neighborhood. Several station site modifications have been developed for stations in the W Dravus area. Dravus 1A (16th) would be vertically arranged but would minimize the station building layout, both in order to avoid bulk/scale impacts and to potentially avoid displacing the QFC by significantly reducing parking loss at the store. This option would require the demolition of a small fast food on an adjacent property to allow construction staging. Preferred Alternative Dravus 1B would site a horizontal station on a diagonal to the street grid, beginning immediately south of W Dravus Street and crossing to 15th Avenue W. This alternative would minimize property acquisitions over other alternatives because it would be located on properties that would already be crossed and affected by the guideways for Alternative 2.1. Two residential properties would be displaced, but the development of the station in the area would remain consistent with the development allowed within the neighborhood commercial zoning of the area. The height of the station would be slightly lower than the other Dravus station alternatives. Height, bulk and scale impacts could be mitigated through design similar to the Crown Hill 1 and 1A stations discussed above. Although the station would cross several parcels, similarly sized developments occur and are allowed within the area. -

The Howe 1 and 1A (West) station would be west of 15th Avenue W in the general industrial zone. Because development and demand in this area could be expected to come from redevelopment from underutilized parcels to the west, the timing of station development would depend on the timing of that development. It should be noted that residential development would be inconsistent with current zoning. SMP would not attempt to change plans or zoning, but would respond if such changes – and future development – occur in the neighborhood through other means. Howe 1 would be a vertical station on a west alignment largely out of the street right-of-way. The property required for the station is partly occupied by an office, warehouse, and self-storage business, but displacements and relocations would not impact other uses. The bulk and scale of the station would not be inconsistent with planned bulk and scale of structures in this IG2 zone, which does not have height limits for most types of uses. The bulk and scale of the station would be similar to that allowed in the IC-45 zoning area on the east side of 15th Avenue W. The longer-term presence of the station building in this location is also likely to be beneficial. The IG2 U/45 zoning that covers much of the neighborhood immediately around the intersection allows a wide variety of industrial and commercial uses. The Tsubota Pipe and Steel Plant is a former heavy-industrial use across from the Howe station alternative site. The timing of plans to redevelop that site is not known at this time, but development of Howe 1 or 1A is not expected to conflict with redevelopment plans. With a Howe 2 (Blaine) station, the Tsubota Pipe and Steel property would be utilized. Because it would be horizontally arranged, the height of the Howe 2 station would be less than with Howe 1 or 1A, but otherwise the effects of the station would be similar to the other alternatives. This station could also improve access to the station from nearby developments to the east, including the Amgen campus, and could allow future connections to nearby commuter or regional rail facilities. Near the Howe 2 (Center) station, switches and guideways would be required to connect the Alternative 2.1 main guideway to access the Interbay Operations Center, but these additional facilities would not interfere with the function of adjacent uses, and would not substantially contrast with current or allowed area development.

Elliott and Mercer 1 (Center) would be primarily located in the street right-of-way, in an industrial/commercial zoning. The multifamily zoning east of the station area encourages multifamily uses, which have grown rapidly over the past decade in this general area. The height, bulk and scale of

this center of street station would be a contrast to the scale allowed in the C2-40 zones to the east and the IC-45 zones to the west. This is largely because of the large street-spanning structures that would be required to support the station structure. The center of street alignment would increase delays for southbound vehicles turning east onto Mercer Street at peak hours, but delays would remain at acceptable levels. Businesses in the neighborhood could see an increase in morning and evening vehicular traffic and parking demand if parking remained unrestricted (see Section 4.1, Transportation), but these impacts would not be significant. In response to comments, the SMP has developed the Elliott and Mercer 1A (Center) option, which would be a vertical station located on C1-40 zoned property off the right-of-way on the east side of the street. The design would not require a station structure fully over Elliott Avenue W in that location, reducing the bulk and scale of the structure in comparison to Elliott and Mercer 1. The station height required would be approximately 50 feet, with elevator overruns over 60 feet in height. Because of area topography, this station can be located more against the hillside and would look more consistent with the planned height and scale of the area, which transitions to midrise zoning (60 foot height, with exceptions for five-foot parapets and for 10-foot rooftop mechanical) immediately uphill and east of the station site. The approaching guideways from Elliott Avenue W would transition from a horizontal arrangement to a vertical, but the effects would be similar to the horizontal arrangement. Mitigating design to break up the appearance of height and massing could be utilized, although the massing of this station would be less than other structures in the vicinity.

Alternative 2.2 (Center of 15th/West Side of Elliott). Alternative 2.2 would feature a connection to the East Bridge and could displace storage space and work area within the Salmon Bay Terminal, including boat repair and maintenance uses. The Dravus 2 (15th) station site on the west side of 15th Avenue W would have less displacement impacts than Dravus 1 (16th), but also would be more removed from the nearby commercial area. Displacement impacts of Dravus 1A and 1B would be similar to Dravus 2. The Howe 2 (Center) alternative station would be a center alignment station with its main mass over the street right-of-way and a smaller station structure outside the right-of-way to the west. This would result in a larger and more visible structure than with Howe 1 (West), but would still not be inconsistent with the wide variety of industrial and commercial uses typical of the neighborhood and allowed under current zoning. Similarly, a potential station location at W Prospect Street, west of the intersection of Prospect and Elliott Avenue W, could involve a mezzanine or vertically arranged station that could exceed heights currently allowed under zoning (IC-45) in order to provide sufficient clearance of rights-of-way below the guideway beam, but the station would be otherwise compatible with existing warehousing and light industrial uses in the area. Elliott and Mercer 2 (West) would be primarily located to the western side of the right-of-way in the Industrial Commercial (IC-45) zone and have similar height and scale impacts as Prospect 3.

The Preferred Alternative for the Interbay segment would feature a horizontal dual beam crossing of the Ship Canal, using the west bridge alignment (2.1.1) and the Dravus 1B station, a future Howe 1A-(Blaine) station, and then transitioning in and out of a vertical configuration at the vertically arranged Elliott and Mercer 1A station. The land use impacts would be as described for these facilities under Alternative 2.1.

Alternative C-1: Interbay Operations Center

Operations Center Alternative C1, which is the Preferred Alternative, would be located in Interbay on the Northwest Center property on W Armory Way, south of the Interbay Athletic Complex and Interbay P-Patch (see Section 4.10, Parks and Recreation). Existing zoning is industrial, which allows a wide range of industrial and commercial uses. The Interbay Operations Center would be consistent with planned height, bulk and scale under the City's comprehensive plan and existing IG2 zoning. The uses anticipated for the Operations Center—maintenance and light manufacturing uses, guidance control headquarters for train operations, and potentially SMP office space—would be compatible with existing uses in the area. Long-term impacts are expected to be minimal given the low-impact nature of maintenance activities and the site's relative isolation. The displacement of the Northwest Center and its affiliated business

operations within the site, as discussed in Section 4.4, Economics, would involve displacing a number of employees. Northwest Center is a Seattle-based non-profit organization that expands the skills, independence, and opportunities of children and adults with disabilities, providing programs of education, job training, and rehabilitation. Some of the people employed or individuals served by the present site could have changed commutes if the Northwest Center were relocated to another area of the city. However, current access to the site is difficult for transit-dependent individuals, bicyclists, or pedestrians; if the Northwest Center were relocated in an area with comparatively improved transit and easier walk or bike routes, impacts to individuals would be minimized.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The effects of the alignment of the Green Line through or around the Seattle Center is the primary differentiating factor for alternatives in this segment. However, the alternatives along W Harrison Street and following Fifth Avenue through Belltown also involve differences in noise, parking, transportation, and property acquisitions that are considered in the analysis.

Scoping comments, comments on the Draft EIS, as well as the high level of general public interest in potential Green Line routes through the Seattle Center have clearly noted the importance of the Seattle Center as a multi-use area that serves a wide range of cultural, recreational, educational, and public space needs for people throughout the region. The Seattle Center Master Plan identifies the area as a vibrant, multi-use facility. Some public comments have stated that the Green Line could be perceived as a distraction by festival-goers and by those who seek out the center grounds for its park-like qualities or for public gatherings. Other comments stated that the monorail is already a major feature of Seattle Center and the extension of the line through the Seattle Center along Alternative 3.1 would be consistent with the kinetic and varied character of current uses of the Seattle Center outdoor spaces. Most of those comments also focused on the impacts of Alternative 3.2 along Mercer Street, which would be inconsistent with aspects of the Seattle Center plans for the theater district area of the Seattle Center.

As discussed in more detail below by alternative, all Green Line alternatives would feature one station on the west side of the Seattle Center, near Key Arena. Two Green Line alternatives would pass through the center grounds: Alternative 3.1 (Seattle Center/Republican) and Alternative 3.3 (Thomas). The presence of either of these lines would create a new visual element on the Seattle Center grounds. Neither alignment would displace major land uses at the Seattle Center or change the overall function of the Seattle Center, although individualized impacts to some facilities and areas of the Seattle Center could occur and are noted below by alternative, following the routes from the west side of the campus to the east.

Both Alternative 3.1 (Seattle Center/Republican) and Alternative 3.2 (Mercer) could require demolition of several of the Northwest Rooms that are currently used for meetings and events, and could impact underground storage and operations facilities of Key Arena. In cooperation with Seattle Center, these facilities would be replaced within a new Queen Anne/Seattle Center station structure. Alternatives 3.3 (Thomas) and 3.5 (Denny) would require demolition and relocation of a retail use at the southwest corner of Key Arena, and would also impact a food preparation area for Key Arena. The guideway for Alternatives 3.3 (Thomas) and 3.5 (Denny) would also cross over the south service entrance area and reserved parking for the Key Arena; while column locations have not been determined, design coordination would be required to avoid these impacts, and displaced facilities would need to be replaced. Some of these uses could potentially be integrated within the new station structure. Alternative 3.5 (Denny) could also require the removal of the Spruce Building, a multistory office building with tenants including Northwest Folk Life Festival, and it would remove the Frol Building, a parking structure owned by and adjacent to the Pacific Science Center.

Alternative 3.1 (Seattle Center/Republican) would follow the Republican Street path, north of the International Fountain green space, while Alternative 3.3 (Thomas) would follow the Thomas Street path

through the center. Either alternative would require the removal of trees and landscaping along at least one side of the paths, and placing guideway columns in locations alongside the paths, as discussed in 4.5, Visual and Aesthetics. Column placements could be coordinated with Seattle Center to avoid conflicts with pedestrian congestion areas. Alternatives 3.1 and 3.2 would pass the Center House, a building eligible for listing in the National Historic Register, resulting in an adverse visual effect, but no other direct impact to the Center House is expected. Alternative 3.2 (Mercer) would follow Mercer Street to the north of the Seattle Center main campus, but would also pass the Mercer Theatre District and require the removal of street trees on the east side of the street, widening of the sidewalk and a narrowing of the 18-foot southernmost lane, eliminating an informal drop off area. However, an existing curb pullout used for passenger loading and unloading, would remain. While the presence of the guideway and the removal of mature trees and landscaping would be a visual change within these areas, the operations of the Green Line would not create impacts that would impair the primary functions of the adjacent performance facilities. However, the street configurations required could be inconsistent with the Center's potential plan for the theater district. Overall, the routes for the Green Line would also follow the original street grids that defined the Seattle Center's layout, and would not reduce or bisect the individual open spaces or green spaces identified in the Seattle Center's Master Plan. Suitable replanting and landscaping could reduce the degree of visual impact.

The Center is host to a variety of entertainment and cultural uses that draw large groups of people to the Center grounds during some times of the year, particularly in the summer. Major festivals such as Bumbershoot and the Northwest Folklife Festival as well as other major cultural events utilize the Seattle Center grounds, including for performance spaces. While Alternatives 3.1 and 3.3 which pass most directly through the Seattle Center grounds could affect the visual setting and some of the previous layouts of these events, as discussed in Section 4.7, Noise and Vibration, the noise and vibration from Green Line operation is not expected to significantly affect performances at any of the outdoor or indoor performance venues.

Alternative 3.1 (Seattle Center/Republican) would require part of the backstage area to Memorial Stadium, used for storage, and would displace two popular attractions within the Fun Forest. Although these activities could be displaced, SMP would coordinate with the Seattle Center to determine column placement and guideway alignment approaches that would minimize loss of the space and to relocate these uses on Center grounds. Alternative 3.1 (Seattle Center/Republican) could continue the existing Seattle Center Monorail route through the EMP, or it could go around the EMP. In either case, some or all of the existing Seattle Center Monorail guideways and the station within Seattle Center could be removed (as well the existing guideway along Fifth Avenue). Other alternative alignments would not pass through the EMP, but most alignments would displace the existing Seattle Center monorail operations.

The removal of the existing monorail at Seattle Center would alter a historic transportation system that carries an estimated 2.5 million trips per year between the Seattle Center and downtown Seattle. The Green Line would be expected to generate higher ridership than the existing monorail and provide two stations to serve the Seattle Center rather than one. Overall, however, the substantial improvement of mobility and access, including more frequent service and hours of operation to the Seattle Center would be supportive to the Seattle Center's long-range goals and the long-term vitality of the Center's varied functions and attractions. It would also help reduce impacts related to transportation and parking that result from major events within the Seattle Center, which would benefit Seattle Center patrons and the surrounding neighborhood.

Alternative 3.1 (Seattle Center/Republican). Alternative 3.1 would place columns in planting areas or the parking lane on the south side of Harrison Street. Tree/landscaping removal along this street and other locations along the route is discussed in Section 4.5, Visual Quality and Aesthetic Resources. The loss of parking is minor, as parking between columns would be provided, as discussed in Section 4.1. Under all alignments, without mitigation, the Green Line could cause noise impacts to residences on W

Harrison Street. As the route approaches First Avenue N and the Seattle Center/Queen Anne 1 (North) station alternative, the guideways would pass over a parcel containing an apartment building (potentially eligible for the National Register as part of a group listing). The Draft EIS identified this building as being demolished, but under revised Final EIS alignment configurations, demolition of this structure (Dalmasso Apartments) would not be required. The property is identified for a full acquisition, although it would be possible (as considered in the Preferred Alternative) that acquisition could be avoided. In this case, the guideway overhead would require air rights or column placement, and visual, shadow and noise impacts would occur. (Adverse impacts to historic resources are discussed in Section 4.11, noise impacts are discussed in Section 4.7, and visual impacts are discussed in Section 4.5.) The Seattle Center/Queen Anne 1 or 1A (North) station would be located to the northwest of the Key Arena on Seattle Center property. For either option, construction of the station would demolish some of the Northwest Rooms that are currently used for meetings, banquets, exhibits, and events (see Section 4.2, Displacements and Relocation). The station would also partly occupy a plaza area and could affect underground facilities used by the Key Arena for storage and other facility operations. The size of the station would be compatible with planned height, bulk and scale in this NC3-85 zoned area, which allows 85-foot height and a variety of commercial and entertainment uses. Some views of Key Arena would be affected (see Section 4.5, Visual Quality and Aesthetic Resources). SMP has been coordinating with the Seattle Center to develop potential design approaches to minimize the potential impacts of the station and create a positive asset for the Seattle Center. SMP has committed to replace the functional space at the North Rooms, replacing lost meeting/exhibit space. The station design could support Seattle Center Master Plan goals to open or “soften” the historic edges of the Seattle Center to provide more integration with and easier access to the neighborhoods to the west and north. A context-sensitive design for the station could minimize effects on views of Key Arena and provide a more integrated public space than currently exists.

The route east along the Republican Street pathway would require columns along the pathway and the guideway overhead and would require removal of trees. However, it would be along an existing pathway for the Seattle Center, with the Mercer Theatre District to the north and other Seattle Center zones to the south. The alignment would pass well north of the International Fountain, centerpiece of the open space and lawn and would not have an adverse effect on the Fountain. Instead, the primary effect would be visual due to the loss of trees and the introduction of the guideway, as discussed in Section 4.5, Visual Quality and Aesthetic Resources, and would not cause significant impacts to the passive enjoyment and community gathering uses that characterize the space. Mitigation would include replacement with mature trees and context-sensitive design. Column placement along Republican Street could be sited to avoid pedestrian congestion points. There would not be adverse noise or vibration impacts to any of the Mercer Theatre District venues (see Section 4.7, Noise and Vibration). During scoping, there were some comments that Green Line operation through the Center would be a distraction during outdoor events at the Center, including performance venues at festivals. Other comments suggested that the monorail is already associated with the Seattle Center and that this kinetic use would be a welcome addition to events at the Center. While the Alternative 3.1 alignment would change the visual experience for festival-goers to the Center, it would not cause substantial noise impacts nor displace Center uses.

The alignment would need a small portion of the Memorial Stadium maintenance area for column placement. This area is currently used for backstage access, Seattle Center landscaping, parking, and operations and storage. The stadium itself would not be altered, and the presence of the Green Line would not affect its use, including noise or visual effects (see Sections 4.7, Noise and Vibration, and Section 4.5, Visual Quality and Aesthetic Resources). In the area between Memorial Stadium and the Center House, column placement could aggravate an existing pedestrian choke point. Additional property acquisitions for the alignment would also impact the Fun Forest by displacing several of its attractions. SMP would work with Seattle Center to relocate that use on Center grounds. The effects of the potential displacement of some Fun Forest attractions would not be significant and are discussed in Section 4.4, Economics.

Alternative 3.1 features two route alternatives related to the EMP. Alternative 3.1.1 would pass through EMP with one or both guideways, and Alternative 3.1.2 would pass around EMP. Because the design of the EMP incorporates the existing monorail guideways, routes around the EMP would change that relationship but would not alter the primary function of the EMP itself as an interactive music museum.

The Seattle Center/Fifth and Broad 1 (Southeast) alternative would be a larger station to accommodate event crowds, and would require acquisition of up to seven parcels that currently involve a variety of existing uses, including parking lots. Alternative 3.1 could also feature a storage track over Denny Way, which could increase the property needs near the Fifth and Broad station. Currently, the properties in the station area are separated from surrounding uses by the confluence of several of the area's major existing arterials and by the grounds of the Seattle Center itself. The removal of existing buildings under the Fifth and Broad 1 alternative and redevelopment of the property as a transportation facility, however, is unlikely to have a significant adverse impact on area land use, and could improve transportation access and pedestrian activity in the area, but it does remove a larger area of real estate from private supply. The station could be up to 60 feet high, which would be within the existing zoning limits and would not substantially contrast in bulk or scale with nearby developments, which already includes several large-scale developments.

In response to comments and to reduce property acquisition impacts, a revised route at Fifth Avenue N. (Alternative 3.1.3) would place the guideways over Fifth Avenue to reach a the modified Fifth and Broad station alternative (1A); this has been included in the Preferred Alternative. The station could also include switches for a Downtown Turnback. The station would horizontally arranged and located on a triangular block on Fifth Avenue N between John and Broad Streets, displacing a surface parking lot and small commercial use. The related guideway alignment would be located over Fifth Avenue N. (north of Denny Way). The reduction in property acquisitions and the reduced height of the station and the adjacent guideway would reduce impacts compared to other alternatives.

Past Denny Way, Alignment 3.1 would follow the same route as the existing monorail down the center of Fifth Avenue, although the guideways would be somewhat higher. Long-term impacts are therefore expected to be less than those associated with the existing monorail because column spacing would be greater and noise impacts at street level would be less.

Belltown 1 (Center-West) and 2 (Center-East) stations are located near the intersection of Fifth Avenue and Bell Street. The station alternatives would rise up to 60 feet above street level, below the height limit for buildings under current zoning, which allows for a variety of commercial and multifamily residential uses. This is well within the height, bulk and scale planned for under the high-density downtown zoning in the area. Belltown 1 would replace two commercial properties and would displace the Seattle Glassblowing Studio, the Belltown Bistro, and Hot Glass Color and Supply. In response to comments, Preferred Alternative station Belltown 1A station has been designed to reduce the acquisitions to a single parcel. The Belltown 2 station alternative would replace a parking lot. The loss of parking is not expected to be significant given local availability (see Section 4.1, Transportation). The displacement impacts for either one of the stations would not result in significant land use or neighborhood impacts. The overall station facilities, including platform areas, would be larger in scale than existing buildings or plats in this area, although the station house itself would be generally within the scale of adjacent developments. Zoning and area plans encourage a high level of development in the area, and the station would support and not substantially reduce the area's goals for future growth.

Alternative 3.2 (Mercer). Alternative 3.2 would place columns in planting areas or the parking lane on the north side of W Harrison Street, which would have similar impacts to all other alignments in this area. Tree/landscaping removal is discussed in Section 4.5, Visual Quality and Aesthetic Resources. The loss of parking is minor but slightly more than Alternative 3.1. Noise impacts to residences (mostly multifamily) would also occur, although the shift in street alignment changes the specific properties affected compared to Alternative 3.1. Impacts related to the Queen Anne/Seattle Center 1 (North) station

are the same as stated for Alternative 3.1. However, after the station, the alignment would travel to the north of the center on the north edge of the Mercer Theatre District. After reaching the north side of Mercer Street, the columns would be located in the existing street right-of-way, and the northern sidewalk would be extended over the columns. The number of traffic lanes for Mercer Street would be unchanged from No Action, although they would be narrowed. This would conflict with some elements of the Seattle Center's "boulevard" plan for the Theatre District (allowing parking and limiting drop offs). Visual and aesthetic elements of the plan are discussed in Section 4.5. Many public comments from businesses, institutions and neighborhood groups on the Draft EIS indicated opposition to a Mercer Corridor alignment, which many parties indicated would be less supportive of the Mercer Theatre District Master Plan, particularly improving for streetscape and operational conditions along the Mercer Street corridor.

After the Seattle Center, this alignment leaves open the option to retain the existing Seattle Center Monorail. Retaining the existing monorail would result in greater impacts to the neighborhood and streetscape than other alternatives, with greater noise, visual, and shading impacts to the Belltown neighborhood. The retention of the existing Seattle Center Monorail guideways would also require the Alternative 3.2 stations to be substantially higher. Mitigation for this impact would be to remove the existing monorail.

In response to the comments, the Fifth Avenue alignment of Alternative 3.2 was modified to relocate the guideway more into the street right of way and further from buildings along the west side of Fifth Avenue in the Belltown area. It would also allow alignment to use the Fifth and Broad 1A (Southwest) station, as discussed for Alternative 3.1. This would restore a traffic lane in the area currently occupied by the existing monorail and would extend the west side sidewalk to the new guideway columns. While this would decrease the number of lanes along Fifth Avenue in this area, no significant traffic impacts would occur and, because this option would increase the distance between the guideway and adjacent noise, shadows and other visual effects identified for Alternative 3.2 in the Draft EIS would be reduced. The wider sidewalk could also allow greater pedestrian activity.-

Alternative 3.3 (Thomas). Between Elliott Avenue W and Queen Anne Avenue N, this alternative is the same as Alternative 3.1. The Seattle Center/Queen Anne 2 (South) station alternative would be at the southwest corner of Key Arena. The station would displace the existing Key Arena ticketing office and the Sonics/Storm Retail Store; the function of these facilities is related to their location at the main entrance to the arena, and relocation would need to be near the existing location or potentially within the new station. Scale and compatibility aspects of the station are similar to the north station, given the NC3-85 zoning, which allows 85-foot height limits, and for a variety of commercial and entertainment uses. The Queen Anne 2 station alternative would be well within these limits. As with all station alternatives, some views of Key Arena would be affected.

The guideway departing the station would traverse the southern portion of the Key Arena area and could displace a food handling/preparation area serving Key Arena. Relocation efforts would need to be closely coordinated. Similarly, the guideway for the route would cross over the main freight loading and access area for the arena, requiring coordination of the guideway and column placement to avoid impacts.

Turning east, the Thomas Street route would have visual impacts to a number of areas within the Seattle Center, but these impacts would not interrupt the continued use of Seattle Center facilities. As with the Republican Street route (3.1), the original alignment of Thomas Street through the center is an established line defining separate zones of the Center, and the presence of the guideway along Thomas Street (3.3) would not physically separate the areas. As discussed in Section 4.7, Noise and Vibration, the noise and vibration from Green Line operation is not expected to disturb performing venues, including the Seattle Children's Theatre or the outdoor performance areas. The route would pass well south of the International Fountain and near the Fisher Pavilion, with its newly developed rooftop plaza. -No additional building removals or relocations would occur along Thomas Street east to the Fifth and Broad

station. The stations and routes after leaving the Seattle Center would be the same as Alternative 3.1, but could align with any route down Fifth Avenue.

Alternative 3.5 (Denny). The Denny alignment would be the same as Alternative 3.3 (Thomas), until the Seattle Center/Queen Anne 2 (South) station. After the station, Alternative 3.5 would continue east to the north side of Thomas Street, requiring the demolition of a multi-story office building. After turning south on Second Avenue N, this alignment would require the removal of a multi-story parking building owned by the Pacific Science Center. The loss of this parking facility, which is the closest major parking facility to the Pacific Science Center, would be an adverse impact. The location of the Denny 3 station alternative across Broad Street from the Pacific Science Center would provide access to Seattle Center along the Second/Denny alignment, but may not offset the impacts due to the loss of parking. The Denny station could be up to 60 feet high, which would be less than the contemplated height, bulk and scale under the existing comprehensive plan and zoning (zoned NC3-85). This station alternative would replace an existing bank building.

The Preferred Alternative would consist of the same features and impacts described for Alternative 3.1 from W Harrison Street, through Seattle Center to Fifth Avenue N, up to the crossing of Denny Way. From there, the alternative would use the west alignment of Alternative 3.2. With the Queen Anne/Seattle Center 1A, Seattle Center Fifth and Broad 1A and Belltown 1A stations, the alternative includes stations that would minimize property acquisitions while providing effective connections to nearby activities. All the east side of Seattle Center and Belltown stations would be consistent with the height, bulk and scale of existing plans and zoning. In Belltown, all stations would be significantly smaller than allowed height, bulk and scale.

Segment 4: Downtown/Pioneer Square Segment

The primary differences in the level of effects that in the Downtown Segment are related to the size and location of stations and their specific acquisitions, and to the alignment of the Green Line and the related changes to City streets and other transportation systems. While some alternatives would involve adverse effects to historic resources within the Downtown Segment (see Section 4.11, Cultural Resources), the effects are generally limited to visual and change of setting impacts and would not impair the continued use of these buildings. The positive benefits of improved access and mobility due to the project would generally accrue to land uses with all of the alternatives.

Several of the stations would acquire parcels that currently provide surface or low-rise structured parking, as well as some properties that are vacant or underutilized given existing zoning. The loss of off-street parking supply could increase overall parking utilization levels in the area, but shortages appear unlikely given the overall supply of off-street parking in the Downtown area.

Other impact areas, including air quality, public services, environmental health, and other related analyses, did not identify adverse impacts of a magnitude that could affect land use. Business and employee displacements (see Section 4.4, Economics) would not substantially alter land use patterns, and relocations could in most cases be accommodated within the area due to ample market availability. Residential impacts are limited and could be avoided. Visual and aesthetic impacts were considered moderate to high in some locations of Downtown, due to impacts to historic resources, increased shadows, and partial obstructions of views, among others. However, given the densely developed environment of Downtown, the impacts would not be considered to be of a level that would impair existing or planned land uses within Downtown, given the many other factors, including infrastructure and amenities that contribute to property value and land use functionality within the Downtown urban core. All of the stations are in areas where zoning allows considerably taller and bulkier structures.

In terms of neighborhood impacts, all alternatives would affect the visual context of some historic resources, particularly in Pioneer Square. The improved access to the Pioneer Square Historic District

and the Pike Place Market Historic District would likely benefit continued economic vitality. In some locations, such as with the Yesler station, the Green Line also has the opportunity to improve enhance existing connections between neighborhoods. The Green Line would also provide improved connections to the other regional transportation systems operating in and to Downtown, including Washington State Ferries, transit at the Downtown Seattle Transit Tunnel, and the transit operating on surface streets.

Some comments suggested that frequent passage of Green Line trains could be a potential distraction for those working in offices at the same level of the alignment, particularly for the west (4.1) and east (4.2) alternatives. The potential for such an impact is considered in this EIS in terms of whether or not the Green Line would substantially impair the viable use of the adjacent properties. A high degree of impact is not likely, given that buildings along the existing monorail remain in productive use, and field reviews of similar elevated structures in cities such as Vancouver, B.C., indicate that office and commercial workers and residents have a low sensitivity to the passage of trains. In fact, the recently constructed Fisher Properties building houses offices for a TV station (KOMO TV) with the same or closer proximity to the existing monorail. The owner of that building has indicated that there is no reduction of rent for the offices closest to the monorail. As a result, existing adjacent office, commercial, and residential uses should not be adversely affected by the visual presence of the Green Line.

The height, bulk and scale of all of the station alternatives within the downtown segment would be consistent with planned development and zoning envelopes and would not be a substantial contrast. Because portions of the stations (including platforms) would extend over the street for the stations on the 4.3 (Center of Second) or 4.4 (East of Center) alignments. The sense of bulk would be greatest for the center of street station options because the station facilities would extend fully over the street.

As discussed above, public comments related to the Downtown segment included concerns about the distance required between buildings and the monorail structures and trains. In response, SMP has provided additional details on the “dynamic envelope” required for the Green Line and the potential for conflicts with adjacent buildings. SMP concluded that the Green Line would not prevent ongoing maintenance or improvement to the adjacent buildings. The dynamic envelope also provides sufficient distance from the property line to allow new developments on the adjacent properties.

Alternative 4.1 (West Side of Second). All alignments would be south of the center of Stewart Street to Second Avenue. Alternative 4.1 would then continue along the west side of Second Avenue. Lane reductions or other streetscape modifications along Stewart Street and Second Avenue were not expected to significantly affect transportation- (see Section 4.1, Transportation), but the loss of on-street metered parking was identified as a significant impact given the high rates of current utilization. Noise impacts were also identified for a residential building along Second Avenue (see Section 4.7, Noise and Vibration).

At the start of the segment, the Fifth and Stewart 1 (Northwest) station alternative would be sited to serve the retail core and connect to the Downtown Seattle Transit Tunnel, as well as many surface bus transit routes. Fifth and Stewart 1A would be in the same location but would reduce property acquisitions and avoid demolition of historic structures. Either station could contribute to improved mobility in the area and would provide a major infrastructure improvement to help meet the demands of growth projected for the Downtown area. A pedestrian connection from the station to Westlake Center could potentially be constructed, linking the new Green Line station more directly to Westlake Center, which the Seattle Center Monorail had directly served. Existing pedestrian connections to that area are well established and already heavily used, so although the pedestrian connection would be an amenity, it may not greatly change conditions from Alternative 4.1 without the bridge. The Fifth and Stewart 2 (Virginia) station alternative would be in the middle of the block between Stewart and Virginia Streets. Fifth and Stewart 2A would also be mid-block but would reduce property acquisition compared to Fifth and Stewart 2, although additional facilities would be placed on street right-of-way, closer to the Westin Hotel. A pedestrian connection to Westlake Center could also be constructed under these alternatives. Overall, the

increased ridership due to the Green Line would be expected to offset potential impacts to Westlake Center stemming from the loss of direct service by the existing monorail.

The Fifth and Stewart 1 station would be closer to the retail core and potentially would provide better pedestrian connections to that area, but would have greater impacts to historic resources due to the demolition of the Centennial Building, a historic property. Fifth and Stewart 1A would avoid the demolition. For both alternative 1 and 1A, the acquisition of an existing surface parking lot would be required. The loss of surface parking could slightly reduce availability of off-street parking in the area, but other off-street parking is available in the area. Other aspects of the station's development, including scale and operations, would be incompatible with the nearby uses and with the planned height, bulk and scale under City regulations.

A station at Second Avenue and Pike Street would serve the Pike Place Market area. The Pike 1A and 1B station alternatives would be of similar height and size, and adverse impacts to land use are not anticipated. The Pike 1B station (the Preferred Alternative) has been configured to eliminate the need for demolition of a historic structure and to provide for better neighborhood interaction. Pike 1B could provide a new pedestrian way connecting to the Pike Place Public Market. Aerial use of the alley between First and Second Avenues could accommodate the reoriented station alternative, while allowing the alley to remain open to traffic.

The Madison 1 (West) station alternative would be on the Federal Reserve Bank property (a historic building) on the northwest corner of Second Avenue and Madison Street. This location would provide convenient access to the ferry terminal three blocks to the west and would provide service to the heart of the Downtown office core and its high concentration of employment. Current zoning for the site anticipates buildings of substantially greater scale and density. If the station were designed to accommodate the potential for future development, it could support plans and zoning seeking to increase the density of this area.

The Yesler 1 (West) and 2 (Center) station alternatives would provide access to the Pioneer Square Historic District and its many uses, including office, retail, restaurant, and entertainment venues, as well as connections to the Pioneer Square station of the Downtown Seattle Transit Tunnel and the passenger ferry terminal. Although an adverse effect to the historic resources within the district has been identified, the overall impact on land uses and neighborhood vitality would likely be positive. The Yesler 1 station alternative would have less impact to historic resources than the larger, center-of-street Yesler 2 alternative.

Alternative 4.2 (East Side of Second). After Stewart Street, this alignment would follow the east side of Second Avenue with a crossover to the west side at Marion Street. The alignment would have to cross the street on bent structures in order to access any of the station alternatives in Pioneer Square. The Fifth and Stewart 3 (Lenora) station would be further away from the retail core than other alternatives, but would still be expected to facilitate improved connections and provide similar benefits as the other station options. However, one of the properties to be acquired and potentially demolished for Fifth and Stewart 3 is eligible for the National Register (Sheridan Apartments). This station alternative would involve residential and business displacements but would not significantly alter the pattern of land uses in the nearby area.

The effects of the guideway from Stewart to Second Avenue would be similar to Alternative 4.1. The guideway along Second Avenue would result in similar overall transportation impacts as Alternative 4.1, including the loss of parking.

The Pike 2 (East) station would occupy an existing surface parking lot. As discussed above, this could reduce the availability of off-street parking within the immediate area, but given Downtown's off-street supply, the loss would not be significant. While direct adverse impacts to existing land uses are not

anticipated, development of the station alone would, in itself, be a substantially less dense use than existing zoning could allow.

The Madison 2 (East) station alternative would be on the east side of Second Avenue, located on an open plaza that was constructed when the Wells Fargo building was developed. The station would avoid displacing buildings or occupants, but the plaza represents one of the limited number of open space areas available to the public and set back from the street within the densely developed downtown office core. This plaza accommodates a range of uses including outdoor concerts.

After the Madison 2 (East) station, the route would transition to the west at Marion and from there have the same effects as Alternative 4.1.

Alternative 4.3 (Center of Second). This route would initially be similar to Alternative 4.1 from the Fifth and Stewart 2 (Virginia) station, but it would turn southwest after Third Avenue to an alignment on the center of Second Avenue, with its Pike 3 (center) station located between Pike and Pine. The curve of the guideway from Stewart to Second could require the acquisition of a property containing the Bon-Macy parking garage, as well as the surface parking lot to the west of the garage, but that garage structure could also be avoided under all alignments. The loss of the Bon's garage would be an adverse impact to one of the major retailers in the Downtown area, and the overall loss of two major sources of parking within the area would be an adverse impact to area land uses. This could be mitigated by redesign of the route to avoid this demolition, similar to the alignments used for other alternatives in this location

The center of street alignment would have higher levels of visual and transportation impacts than the other alternatives. The visual impacts are discussed in detail in Section 4.5, Visual Quality and Aesthetic Resources. As discussed in the review of height, bulk and scale issues for the downtown area, all of the Alternative 4.3 stations would have comparatively higher contrasts in terms of bulk because the station facilities would completely straddle the street.

The Pike 3 (Center) station would occupy the same properties as Pike 1A (West) with Alternative 4.1, with similar impacts related to property acquisitions. Its center of street configuration with a mezzanine was identified as a significant adverse impact to visual quality, as discussed in Section 4.5, Visual Quality, and overall it would be less compatible with surrounding existing or planned uses.

The Madison 3 (Center) would be a center platform station with a mezzanine over the center of Second Avenue, with a station building and access occupying the plaza of the Wells Fargo Building. The resulting impacts of the station to land use would be as discussed for Alternative 4.2's Madison 2 (East) station, but the station would also be more likely to intrude on existing properties, due to the extent of its structure over the street. While the height and scale of the station facility would be smaller than most developments in the area, the appearance of bulk would be greater because it would occupy an existing open space and straddle the street.

The Yesler 2 (Center) station alternative would provide access to Pioneer Square, the Downtown Seattle Transit Tunnel, and the passenger ferry terminal, but it would also involve adverse effects on historic resources. Both alternatives could affect public views and historic resources (see Sections 4.5, Visual Quality and Aesthetic Resources, and 4.11, Cultural Resources, for more information). The height and scale of the station facility would be smaller than other developments in the area. The appearance of bulk would be greater for Yesler 2 than for Yesler 1, because the Yesler 2 facility would straddle the street.

Alternative 4.4 East of Center of Second. This route would initially be similar to Alternative 4.3 (Center of Second), beginning with the Fifth and Stewart 2 or 2A (Virginia) stations, but on Second Avenue it would have an alignment in an existing traffic lane east of the center of Second Avenue. Similar stations as featured in Alternative 4.2, East of Second, would be involved, although the station buildings would extend further into the street. However, the stations for Alternative 4.4 would not be

required to fully straddle the street, as would occur with Alternative 4.3. The sidewalk and lane configurations along Second Avenue would be modified and a reduction in street capacity and the loss of on-street and off-street parking would occur, similar to Alternative 4.3. Other impacts, including noise, visual and historic and cultural effects would also be most similar to Alternative 4.3.

The Preferred Alternative would feature Alternative 4.1, the West of Second street alignment. Fifth and Stewart 1A, which sites the station on an existing surface parking lot and reduces property acquisitions, including avoiding the demolition of the Centennial building, would be used, as described for Alternative 4.1. The seven properties that would be fully acquired for all stations are on the lower end of the range for Downtown Segment alternatives, and in several locations involve existing parking lots.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Both Alternatives 5.1 and 5.2 would have similar minor land use and neighborhood impacts in the SODO Segment, which traverses the Duwamish industrial area. The Draft EIS concluded that there were no significant differences among the type of businesses affected by proximity of the Green Line for either alternative, and the nature of impacts are expected to be minor. Public comments on the Draft EIS indicated concerns of businesses in two primary locations: along Third Avenue S in the area south of Safeco Field, and in the S Lander Street/First Avenue S area. For either alternative, lane reductions or loss of up to 200 unrestricted parking spaces would occur, but would be in low-utilization areas where significant transportation impacts would not be expected and therefore would not cause impacts to land uses (see Section 4.1, Transportation). Alternative 5.2/(s) could require more individual property displacements and relocate more businesses (see Section 4.2, Displacements and Relocation), based on the station alternatives it includes in the Lander area, but at the northern portion of the corridor along S. Third Street, it would be further from existing businesses and their active loading and access areas, compared to Alternative 5.1, which would be adjacent to the BNSF tracks. Overall, the full acquisitions related to guideways and stations are similar, although Alternative 5.2/(s) would require more air rights due to the diagonal crossing between Third Avenue S. and Utah Avenue S. None of the alignment alternatives is anticipated to affect the overall neighborhood character or overall land use pattern of the SODO industrial area. There is the potential for column placements of the 5.1 alignment alternative to affect access for some industrial properties or other businesses along Third Avenue S. This impact would be lower for Alternative 5.2/5.2(s), which is the Preferred Alternative, given the east side (5.1) alignment's closer proximity to businesses. Although businesses also indicated concerns over noise, vibration, and visual/aesthetic issues, these impacts would be minor and the presence of the Green Line would not involve a high degree of change over existing conditions in the industrial area.

A Green Line station at Weller/King Street would provide access to Pioneer Square, King Street Station, the International District, Seahawks Stadium, Exhibition Center, and Safeco Field, and effects of all the Weller/King station options would be very similar. Station height would be approximately 55 feet to 65 feet, which is within the anticipated height, bulk and scale for the PSM 85-120. Both Weller/King 1 and Weller/King 2 (Event) alternatives would be located along the extension of Third Avenue S at the Weller Street Pedestrian Bridge. Weller/King 1 would be a smaller station, while Weller/King 2 would be sized to handle crowds from large events, such as major spectator sports events. Switches and storage for a Downtown Turnback could be included with either station and would not result in a marked change in the character of the area.

All of the Weller Street station alternatives would displace a limited amount of parking in the surface parking lot to the north of Seahawks Stadium, which is as event parking for the Seahawks Stadium and Exhibition Center. No other businesses depend exclusively on supply from this lot, and utilization is moderate except for during events at the Stadium or at Safeco Field. No substantial adverse impacts to land use or community character are anticipated, aside from the impacts to historic properties noted in Section 4.11, Cultural Resources. The station would have the potential to provide neighborhood and community benefits and encourage increased community interaction. The station is in the Pioneer Square

Historic District but borders the Chinatown International District urban center village, and the station near Seattle's major intermodal transportation hub would provide increased mobility and transit access for the International District, including the populations of low income and minority individuals in the area. The Weller/King station would help relieve traffic congestion after events at Seahawks Stadium and Safeco Field.

The Safeco Field station alternative would provide access to Safeco Field. Station height would be relatively high because of the necessity for the Green Line guideway to overfly the SR 519 overpass planned by WSDOT in this area. No significant adverse impacts to community character or land use would be expected and the height, bulk and scale of the station structure would not be inconsistent with structures allowed by existing zoning on this IG-2 parcel, which has no height limit for most uses. The station could provide enhanced mobility to event-goers on game days (see Section 4.1, Transportation for more information). Single beam options would involve similar effects as the dual beam arrangement.

In transitioning from a Third Avenue S alignment toward S Lander Street and First Avenue S or Utah Avenue S, the guideways for either Alternative 5.1 or 5.2 would require partial acquisitions of existing properties featuring industrial, manufacturing or business uses, as well as an administrative and training center for Seattle Public Schools. Alternative 5.2/5.2(s), which involves a diagonal crossing of parcels to reach First Avenue S, would be closer to more businesses, but given appropriate design coordination with the involved property owners, the alternative is not expected to substantially affect ongoing use or operations except for properties acquired for station alternatives. The refined 5.2/5.2(s) alignment would slightly change the properties affected, but the effects would remain similar and minor.

The Lander station alternatives would provide access to central SODO. Several of the station options would provide bus transfer or layover areas, but all would have similar effects on nearby land uses. Station height would range from approximately 45 to 60 feet for the stations, depending on the alternative selected. The IG2 and IG1 zoning allows for a variety of intense commercial and industrial uses, with no height limit for most uses and 85-foot height limit for other uses (such as office uses). All Lander stations would be compatible with the planned for height, bulk and scale for the area. -

The Lander 4 station alternative would acquire the parcel containing the Home Depot building and several other businesses. (This same property is also being considered for Alternative C2, SODO Operations Center). In addition, the Lander 4 station would involve a guideway that would acquire a portion of the existing parking facility in front of the Starbucks Center. The acquisition of parking areas for the Home Depot could affect the ongoing viability of the business and could warrant the full displacement of the business. Home Depot is a large employer in the area, and the property is also one of the only major home improvement warehouse stores in this portion of Seattle. The C2 Operations Center alternative would also require the displacement of the St. Vincent de Paul Mattress Factory, a non-profit organization that recycles mattresses to fund social service programs.

The SODO Operations Center Alternative displacements are noted above. The bulk and scale of the Operations Center would be similar to other large uses in the area (e.g., Pacific Iron and Metal Fabrication, SODO Center, and the Seattle Public Schools Stanford Center) and would be consistent with the height, bulk and scale contemplated in the area's comprehensive plan designation and allowed by the existing industrial (IG1) zoning. The uses of the Operations Center would be compatible with the existing uses in the neighborhood and with underlying industrial zoning.

The Preferred Alternative involves a horizontally arranged guideway between Yesler Way and S Royal Brougham Way, with switches south of the Weller/King 2 station for a Downtown Turnback. The alignment would also maintain truck and emergency vehicle access to the stadiums, and overall impacts in the north end of the segment would be minor, as described for Alternative 5.2. A single beam guideway would be used for an alignment along the west side of Third Avenue S. This alignment would minimize access and circulation impacts to businesses, and respond- to community comments received on

the Draft EIS. For the alignment from Third Avenue S to S Lander Street, the alternative would feature a horizontally arranged guideway with switches to the south and north of the Lander station to allow for the transition between single and double beam guideway. The route would be diagonal to the street grid and passing to the north of the Seattle Public Schools' John Stanford Center for Educational Excellence, as well as over other industrially zoned properties, requiring air rights. This is not anticipated to substantially affect the use or redevelopment of these properties consistent with existing zoning designation or the comprehensive plan. The route would reduce acquisitions compared to other alternatives, including avoiding the use of the Home Depot property. However, the guideway would still require air rights of a southeast portion of the Starbucks Center parking lot; which could affect but not eliminate future potential to develop the remainder of the parcel consistent with existing zoning, and property owners would be provided compensation as discussed in Section 4.2. As stated for Alternative 5.2/(s), the overall land use impacts would not be significant.

Segment 6: West Seattle Segment

The Green Line alternative alignments for West Seattle would extend from S Horton Street and the BNSF tracks in SODO to Morgan Junction in West Seattle. The potential for long-term impacts to land use or neighborhoods from Alternative 6.1 (West Seattle I) and Alternative 6.2 (West Seattle II) are anticipated to be similar, low to moderate, and are primarily related to full property acquisitions, noise, and parking impacts.

Alternative 6.1 (West Seattle I). Overall acquisitions for this alternative, which would be aligned on the West Seattle Bridge, in the center of SW Avalon Way, the northwest side of Fauntleroy Way SW, the north side of SW Alaska Street, west side of 42nd Avenue SW, and center of California Avenue SW, would affect nine parcels, mainly in station areas. No residences would be displaced with Alternative 6.1, but nine properties could be acquired and up to 11 businesses displaced.

Alternative 6.1 could eliminate on-street as well as off-street parking spaces. The impact of loss of on-street spaces to businesses or residences is not expected to be significant given available supply and moderate utilization (see Section 4.1, Transportation). The loss of off-street parking could be significant to certain individual businesses without mitigation. Similar to the Ballard segment, the West Seattle station alternatives would have the potential for hide-and-ride parking impacts in station areas, which could reduce parking availability if parking remained unrestricted. As mitigation, the SMP will be establishing Restricted Parking Zones with the City of Seattle.

In most locations, the guideways would avoid the loss of travel lanes, but in some locations on-street parking could occur, as discussed in Section 4.1. Along Fauntleroy Way SW, alignments are considered on either side of the street. Public comments have indicated the community considers access and parking on this street to be important to community goals to strengthen the continued development and economic vitality of the area. The EIS analysis does not indicate that the loss of parking, visual presence of the guideways, or minor changes in transportation conditions would be likely to significantly affect land use patterns or neighborhood character and function. On California Avenue SW, overall transportation conditions with the 6.1 alignment would slightly worsen compared to Alternative 6.2 or No Action due to the placement of the guideway in the center of the street. However, a west side alignment (Alternative 6.1.6/6.1.6(s)) has been evaluated to minimize traffic impacts. With the Green Line guideway in the middle of the street, east side businesses could remain more visible to potential customers than with Alternative 6.2.

Without mitigation, Alternative 6.1 would cause noise impacts to some residences along SW Yancy Street, SW Avalon Way, and California Avenue SW and within a block on either side of the alignment alternatives (see Section 4.7, Noise and Vibration). The majority of residences are on California Avenue SW. Overall impacts to general land use patterns and plans are not expected to be significant, regardless of the location of the alignment relative to the street. The guideway(s) would be visible to businesses and

residences along these streets, and street trees would be removed, but given urban design approaches as discussed above, aside from visual change the alternatives would not otherwise affect the character or function of the neighborhoods.

The guideways would be generally at or lower than zoning heights allowed for new buildings. Stations would be within the height, bulk and scale contemplated in the City's planning and zoning with the possible exception of station alternatives at Morgan Junction where the NC3-30 zoning limits structure height to 30 feet. In addition, the Morgan Junction 1 and Morgan Junction 1A station alternatives would be on sites adjacent to single family (SF5000) zoned areas (maximum height of 35 feet at peak of roof) and the Morgan Junction 2 station alternative would be within _ block of the single family zoned area to the west. Within one to two blocks of the Morgan Junction station alternatives, there are low-rise multifamily zoned areas (L2 and L3) with base structure height limits of 25 and 30- feet (an addition 10 feet is allowed for rooftop equipment). The Morgan Junction 1 and Morgan Junction 2 station alternatives would be over 50 feet in height, with elevator equipment overruns over 60 feet in height, which would contrast significantly with the height allowed in the area and planned for under the City's comprehensive plan. The Preferred Alternative station (Morgan Junction 1A) terminus-style station will mitigate this height/scale impact because it would eliminate a platform level, making the top of roof of the station between 40 to 45 feet, which would be more compatible with existing zoning and planned development than other station alternatives. Other height/bulk/scale impacts could be mitigated by design solutions such as upper-level setbacks from residentially-zoned areas, landscaping and modulation to break up bulk, breaking up massing into smaller design units, building transparency on upper levels, and other design techniques. Switches would be required at the Morgan Junction 1A station in order to accommodate the single beam operation that makes the terminus station possible. As discussed in Section 4.4, Economics, the increased activity and mobility in station areas could also improve economic opportunities for nearby businesses.

A subsegment Alternative, 6.1.6/6.1.6(s), has been developed for an alignment on the west side of California Avenue SW. This would place the alignment (possibly in a single beam configuration) further from the majority of multifamily residences along the street, which are along the east side of the street, although multifamily developments occur on both sides. While there are variations in terms of visual, parking and noise impacts, the differences are not substantial and would not affect the overall pattern of land use in the area.

Displacements for the individual stations for Alternative 6.1 are detailed in Section 4.2, Displacements and Relocation, and remains similar for most alternatives. The Avalon 1 (Center) station would displace three fast food restaurants. The Alaska Junction 1(42nd/Edmunds) station would displace a medical/dental office and a parking lot used for a large retail store; the supply of parking may need to be replaced to avoid an impact to the business. The Morgan Junction 1 (West) station alternative would displace two small businesses. None of the acquisitions or displacements would be considered to have an adverse effect on overall existing land uses or future land use plans in the areas.

The Avalon 1 (Center) station, Alaska Junction 1 (42nd/Edmunds) station, and Morgan Junction 1 (West) station would be located in significant neighborhood commercial business districts. The presence of a Green Line station and the related station area activity within each of these areas would be compatible with existing and planned land uses. The Delridge 1 (26th) station is located in a less developed area and immediately across the street from single family residential areas; it would therefore be less compatible, but not incompatible, with existing and planned land uses. Improved access to the Longfellow Creek Greenspace would benefit the public to a degree, but would visually impact the creek greenspace; given appropriate design and construction coordination, it would not conflict with the objectives of the Longfellow Creek Watershed Action Plan.

In terms of neighborhood impacts for Alternative 6.1, no public service facility or major community resources would be removed or adversely affected. The overall property acquisitions and related

displacements of residents, businesses, or employees are relatively small in number and not concentrated. The development of the Green Line stations and facilities would not create a substantial barrier to existing movements or interaction. The project would benefit the surrounding neighborhoods, particularly near station areas. Mobility for many West Seattle residents would be enhanced with the Green Line, which would improve reliability, travel times, and service levels for transit riders and provide improved connections to the regional job center in Downtown Seattle. Frequent and accessible monorail service could also increase interaction between existing neighborhood business areas on California Avenue SW. As noted in Section 4.9, Public Services and Utilities, emergency response times with Alternative 1.2 could increase slightly in some locations due to the elimination of the center turn lane on 15th Avenue NW.

Alternative 6.2 (West Seattle II). Fewer full acquisitions would be required for this alternative, which would be aligned on a new bridge paralleling the West Seattle Bridge, on the south side of SW Andover Street, center of SW Avalon Way, west side of 35th Avenue SW, north of SW Alaska Street, east side of 44th Avenue SW, and east side of California Avenue SW. It would acquire four full parcels, mainly in the Alaska Junction station area. No residences would be displaced. However, up to 11 businesses would be displaced. A modified 35th Avenue SW alignment and station combination at 35th Avenue SW would feature an alignment in the center of SW Avalon Way to 35th Avenue SW. The alignment would turn south on to the center of 35th Avenue SW at SW Avalon Way and then would turn west over 35th Avenue SW to the north side of SW Alaska Street, which it would follow to the Alaska Junction. The associated station (Avalon 2B) would be a side platform located on the west side of 35th Avenue SW, across the street from the Avalon 2A – 35th station alternative. The Avalon 2B location would avoid the use of West Seattle Stadium park property, as well as impacts to the northbound travel lane; these impacts are discussed in more detail in section 4.1 (transportation), section 4.5, Visual Quality and Aesthetic Resources, and 4.10, Parks and recreation. The guideway alignments along SW Alaska Street, either in the center or to the north, would be similar in terms of land use effects, although the transition of the 6.2.2 guideway from the center of 35th Avenue SW to SW Alaska Street would require up to two property displacements, including the West Seattle Herald building, a community paper. Alternatives 6.2 and 6.2.1 would also displace the Herald building but would avoid an adjacent office building.

Alternative 6.2 has the potential to remove more parking spaces than Alternative 6.1, but access and parking on California Avenue SW would be slightly better the guideway and columns would be placed on the east side of the street. Hide-and-ride impacts in station areas would be similar to Alternative 6.1 and SMP would institute residential parking zones in appropriate areas with the City of Seattle in order to mitigate those impacts, especially in the Morgan Junction area. With the monorail on the east side of the street, east side businesses could be less visible to potential customers. Noise impacts would be fewer than for Alternative 6.1, mainly affecting residences on the east side of California Avenue SW.

Displacements for the individual stations for Alternative 6.2 are detailed in Section 4.2, Displacements and Relocation. The Alaska Junction 1 (44th/California) station would displace three parcels used as a parking lot for Junction area patrons and employees. Mitigation may be needed to avoid impacts to the area businesses. The Morgan Junction 2 (Center) station could acquire one commercial parcel. In addition, the station would be partially sited in the parking lot of a neighborhood grocery store, which could have an impact on that business, although monorail access to the business could partially offset that impact. None of the acquisitions or displacements would be considered to have an adverse effect on overall existing pattern of land uses or future land use plans in the areas.

As with Alternative 6.1, the Alaska Junction 2 (44th/California) station and Morgan Junction 2 (Center) station would be located in significant neighborhood commercial business districts. Height, bulk and scale impacts at Morgan Junction are discussed above. The presence of a Green Line station and the related station area activity within each of these areas would be compatible with existing and planned land uses. The Avalon 2 and 2A (35th) station would be further removed from the commercial district, but the use would be compatible with the current use of the area as a bus transfer point. The height of the station would be reduced with Avalon 2A, but both stations would be similar in scale to other allowed developments in the area. As with Alternative 6.1, the Delridge 2 (Andover) station would be located in a

less developed area and would be less compatible, but not incompatible with existing and planned land uses. The Delridge 2 (Andover) station would be further removed from Longfellow Creek. This alternative's new bridge over the Duwamish Waterway would be designed to accommodate the reasonable needs of navigation and marine uses, and no significant impact to existing land uses or planned land use is anticipated.

Alternative 6.3(s) (Delridge – North Subsegment). This subsegment alternative would be north of the steel plant and south of the western approaches to the West Seattle Bridge. The route would avoid the center of the Delridge area, traveling on a single beam configuration from the West Seattle Bridge to the south side of SW Spokane Street, before turning south to align with the center of SW Avalon Way. The station associated with this alternative would be a side platform station on the south side of SW Spokane Street, about 400 feet west of the intersection with Delridge Way SW. Given the predominately industrial nature of the area and the intensity of adjacent transportation uses, no significant adverse impacts would be expected. However, the location of the station would also not provide strong opportunities to support or enhance business activities in the Delridge area. Both the station and guideway in this area would be quite high due to height of the guideway as it comes off the West Seattle Bridge (as much as 80 to 100 feet), but given the existing land uses (steel mill and freeway), the height and scale of these Green Line structures would not be incompatible. Moreover, the City of Seattle's planning (Industrial) and zoning (IG2) designations in this area allow for uses structures of similar height and scale and of significantly greater bulk.

Alternative 6.4/6.4(s) (Andover/Yancy Subsegment). This route, similar to Alternative 6.1, would approach the Delridge station area crossing diagonally between SW Andover Street and SW Yancy Street for a station east of Longfellow Creek. The alignment and station location reduces proximity impacts to Longfellow Creek, but the overall land use effects would be similar to those described for Alternative 6.1. A no-station alternative along this alignment with a single beam configuration could also be implemented.

Alternative 6.5 (Genesee Subsegment). With this alternative, horizontally aligned guideways would travel from the West Seattle Bridge along the west side of Delridge Way SW, cross over the intersection with SW Andover Street, and align with the west side parking/loading lane of Delridge Way SW. The guideways would curve to the west side of Delridge Way SW through the station area, south of SW Andover Street, but would occupy a west side parking/loading lane of Delridge Way SW until curving to align with the south side of SW Genesee Street. The guideways would follow the south side of SW Genesee Street until curving to the center of SW Avalon Way. The transition to SW Genesee Street would require the acquisition of several residential properties, and the north side of SW Genesee is zoned lowrise-duplex-triplex. Some of these displacements could be avoided by utilizing a vertically-arranged station. The presence of the Green Line monorail structure would be a strong contrast to the character of the nature, in large part because its height and scale would be significantly greater than typical or planned development for the area. The land use to the south is West Seattle Stadium Park and Golf Course, and a property used by the State of Washington Department of Social & Human Services (DSHS); the guideway would represent a visual contrast, but is not expected to substantially alter the use or viability of these properties. Because the guideway would need to be quite high in this area (approximately 80-100 feet) in order to ascend the steep grade on SW Genesee Street, the height and scale of the guideway and larger diameter for columns would be out of scale with the development on lowrise duplex/triplex (LDT) lots and park lands on either side of the SW Genesee Street right-of-way. In combination with the acquisition of the residential properties in this area, the alternative would negatively affect the character of the neighborhood.

The Delridge 4 station alternative would be associated with Alternative 6.5 and would be a side platform station with entry building and station site outside the right-of-way line on the west side of Delridge Way SW. As noted above, however, a vertical station could be used in order to minimize displacements. The impacts of the station would remain within the range for other alternatives in the area, although the station would be further from the Longfellow Creek greenspace and would consequently have no impact on that

greenspace. The Delridge 4 station would be located in a C1-65 zone and would be consistent with the height, bulk and scale of structures planned for and allowed under existing plans and regulations. While the footprint of the station would not be large, it would be 50 to 55 feet, with elevator penthouses up to 65 feet. The zoning immediately south of the station is duplex/triplex (LDT), which has a height limit of 25 feet (35 feet to pitched roof). Design mitigation, such as landscaping, modulation, varied building materials and upper level transparency, could help smooth the transition impacts from structures allowed in the C1-65 zone. The Delridge station would be on a portion of a larger parcel housing an office of DSHS. While some parking could be displaced, access to the office would be improved, particularly for individuals without the use of an automobile, and the overall effect on the community resource could be beneficial.

4.3.2.2 Consistency with Adopted Plans and Policies

Planning documents relevant to the Green Line include state, regional, city, and neighborhood plans. As with the previous Seattle Popular Transit Plan Programmatic EIS, this EIS references regional high-capacity transit planning efforts, including Puget Sound Regional Council's (PSRC) *Destination 2030* (the Metropolitan Transportation Plan and Regional Transportation Plan), Regional Transit System Plan, *Sound Move*, and Seattle's Intermediate-Capacity Transit Study. All of the plans recognize the need for an interrelated and interdependent multi-modal region wide transit system. The Metropolitan Transportation Plan encourages transit services and policies that promote convenient transfers between transit modes, encourage land use patterns that support transit, support vehicle trip reduction, and promote linkages with high-capacity regional transit. The Green Line supports these policies.

SMP would cooperate with other transit providers to promote convenient transfers. The Green Line will serve and support Seattle's urban villages and connections to the urban core, which will promote transit-oriented land use patterns and supports commute trip reduction to Downtown Seattle, the largest workplace in the Puget Sound region, and to other major employment areas such as the SODO Center. The Green Line would also connect with high-capacity transit at the proposed Weller/King Street station. The Metropolitan Transportation Plan (MTP) also supports intermediate-capacity transit (such as monorail technology) along the Green Line corridor. The specific Green Line route is included in the MTP for air quality modeling purposes.

The Green Line is also consistent with Seattle's Intermediate-Capacity Transit Study because the Green Line would serve one of the specific corridors identified as the City's transit priority network in the study. In sum, the Green Line proposal is consistent with regional plans as well as the Seattle Comprehensive Plan, as discussed in more detail below and in Draft EIS Appendix U.

Specific development regulations such as zoning and special review district requirements are not evaluated in this Draft EIS. However, detailed design plans for the proposed Green Line will comply with applicable zoning requirements. The Green Line will be subject to permitting and approval by the City of Seattle, and this EIS is intended to support the City's consideration of environmental impacts in its permitting decisions. The following summarizes the City of Seattle permits required by Department.

- **Seattle Department of Transportation.** It is anticipated that the Seattle Department of Transportation (SDOT) would review all Green Line guideways for approval, whether on City rights-of-way or on right-of-way owned by SMP.
- **Seattle Department of Design, Planning and Development.** The Seattle Department of Planning and Development (DPD – formerly the Department of Design, Construction and Land Use or DCLU) would review for approval all Green Line stations, the Operations Center, and other Green Line facilities (primarily power substations when located outside of stations). DPD would also review any applications for shoreline permits required for work in the City's Shoreline District, which could include the proposed bridge crossings at the Lake Washington Ship Canal and the Duwamish Waterway.

- **Pioneer Square Preservation Board.** A certificate of approval from the City of Seattle Department of Neighborhoods after review by the Pioneer Square Preservation Board will be required for work in the Pioneer Square Historic District.
- **Monorail Review Panel.** The design of Green Line project elements will be reviewed by the City's Monorail Review Panel (MRP), which consists of members of the Design Commission, the Planning Commission, and neighborhood Design Review Boards. The MRP will make recommendations to other City departments, including the Mayor, City Council, SDOT and DPD, on project design.

Appendix U (which is located in the Draft EIS) summarizes the discussion of the relationship between state, regional, and local plans, and a detailed discussion of applicable Seattle Comprehensive Plan, Shoreline Master Program, and Seattle Center Master Plan guidelines. The Green Line would support the general public goals and objectives of these plans, which strongly encourage transit, particularly along the general route of the Green Line.

4.3.2.3 Coastal Zone Management Act

The State of Washington adopted the Washington Coastal Zone Management Program (CZMP) pursuant to the federal Coastal Zone Management Act of 1972. All of the state's 15 coastal counties, including King County, are included within the scope of the CZMP. This includes the entirety of the City of Seattle and all alternatives for the proposed Green Line. Prior to the issuance of the Coast Guard's Record of Decision (ROD) on any bridge permit for the Green Line, the Coast Guard will need to receive a state certification that the bridge constructed for the Ballard Crossing will comply with the enforceable policies of the CZMP. For the Green Line, the certification is prepared by SMP and forwarded to the Washington Department of Ecology (Ecology). Ecology must review and approve the certification prior to ROD issuance by the Coast Guard.

The enforceable policies of Washington's CZMP consist of the following state of Washington environmental statutes:

- State Environmental Policy Act (SEPA)
- Shoreline Management Act (SMA), including local government shoreline master programs
- Washington Clean Water Act
- Washington Clean Air Act
- Energy Facility Site Evaluation Council (EFSEC)
- Ocean Resource Management Act (ORMA)

Compliance with SEPA will be shown by completion of the Final EIS for the Green Line. Compliance with the SMA consists of compliance with the policies of the SMA and compliance with the substantive regulations and policies of the Seattle Shoreline Master Program. Appendix U discusses how the Green Line will comply with the policies of the SMA and the policies of the Shoreline Master Program. The Green Line also complies with the substantive requirements of the Shoreline Master Program because bridges are a permitted use in all shoreline environments through which the Green Line would pass at the Ship Canal and at the Duwamish Waterway.

Section 4.6, Air Quality discusses how the Green Line complies with the Washington Clean Air Act.

Section 4.14, Water discusses Washington's regulatory framework for Clean Water Act compliance and the methods that will be used to comply with water quality standards. Prior to issuance of the Coast Guard's ROD for bridge approval, it will be necessary for Ecology to issue a certification under Section

401 of the Clean Water Act concluding that there is reasonable assurance that the project will meet all applicable state water quality standards. EFSEC and ORMA are not applicable to the Green Line.

4.3.2.4 Impacts of the No Action Alternative

Under No Action, existing land uses and planned land use conditions would remain unchanged. No direct impacts would be anticipated, but the transportation and mobility benefits of the Green Line project also would not occur.

4.3.3 Mitigation

The analysis of land use and neighborhood impacts considers the combined effects of other related impacts on land use; this includes noise and vibration, transportation, visual quality, and others. The following discussion incorporates the potential mitigation measures that these other areas have identified to reduce impacts below a level of significance, and are not repeated here. Similarly, where significant unavoidable adverse impacts such as noise have been identified in other sections, they are not repeated here. Potential design mitigation for height, bulk and impacts is discussed above.

Alternative 1.1 (West Side of 15th), with a NW Market 1 (SW) station. The partial acquisition and displacement of a portion of a drugstore/pharmacy parking could be mitigated.

Alternative 2.1.1 (West Bridge Connection). The ship repair facility and its employees that could be displaced by the loss of marine railways might be mitigated by a reconfiguration of the site and the use of specialized equipment that would allow ship repair operations to continue, and no displacement of employees would be expected.

Alternative 2.1.2 (Far West Bridge Connection). Column locations have not been determined, but potential mitigations identified in Transportation to avoid or reduce impacts to navigational movements in the Boat Turning Basin could also mitigate impacts to the Port of Seattle facilities.

Alternatives 3.1, 3.2, 3.3 and 3.5. Stations at the Northwest or Southwest corner of the Key Arena would displace operational areas considered essential to the Key Arena's operations. Replacing these facilities in reasonable proximity to the Arena, including by integrating them within the station structure, would avoid the impact.

Alternative 3.1 (Seattle Center/Republican). The displacement of two Fun Forest attractions could be mitigated by the removal of the existing Seattle Center Monorail station, which would provide area suitable for their relocation.

Alternative 3.5 (Denny). The removal of the Frol Building parking structure adjacent to the Pacific Science center could be mitigated. The introduction of a nearby station could also provide off-setting benefits, reducing the level of impact.

4.3.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts to land use plans or neighborhoods are anticipated. Localized impacts from height, bulk, and scale could generally be mitigated through design. However, Alternative 6.5, Genesee, would introduce the guideway and columns at a height and scale that would be significantly out of scale with existing and planned uses, and could not be mitigated.

4.4 ECONOMICS

This section describes the potential impacts of the Green Line on the economy of Seattle and the Puget Sound region, including the net economic benefits from improved travel time and reliability for transit users from the system, the employment and business income associated with the Project's construction, and potential impacts to the revenues of local governments. It also incorporates information presented in the Seattle Popular Transit Plan Programmatic EIS.

This section is prepared in compliance with the National Environmental Policy Act (NEPA). The State Environmental Policy Act (SEPA) requires analysis of employment impacts, but does not require economic analysis. However, Seattle's ordinance implementing SEPA includes economic impacts. The project's potential impact on population is discussed in Section 4.3, Land Use and Neighborhoods. A related analysis of business and housing displacements as well as other population impacts is contained in Section 4.2, Displacements and Relocation.

Construction of the Green Line, as approved by Seattle voters, will be financed by a local motor vehicle excise tax of 1.4 percent. Revenues from the motor vehicle excise tax would be used to back construction bonds that would be spent over approximately five years. A benefit-cost analysis of the Project indicates that the benefits will exceed the costs in total, present value terms. In addition, the five year construction of the Green Line (funded from future MVET) would result in an infusion of new money into the local economy that would generate demand for a variety of construction-related goods and services during the years of construction. The net transportation benefits and the economic activity during construction will both have a positive impact on tax revenues to state and local government. Finally, the construction of the Green Line will affect some local businesses within each Segment. This section describes these four categories of economic impacts: long-term travel benefits, regional employment and income during construction, incremental tax revenues to state and local governments, and localized impacts on business and employment.

4.4.1 Affected Environment

Since 1960, the Puget Sound economy has performed well compared to the overall growth of the U.S. economy.¹ The region currently has approximately 1.356 million workers (FDIC 2003), and its underlying economy has remained strong, with per capita wage rates for these workers high relative to national wage rates. Per capita income in King County was \$46,494 in 2001 (PSRC 2003b), compared with \$31,544 in Washington State as a whole and \$29,884 for the United States (PSRC 2003b). Total employment income in the Seattle-Bellevue-Everett area in 2002 was \$63.176 billion.

Despite its underlying strength, the economy has entered an economic downturn over the last few years, during which unemployment and personal bankruptcies have increased, job growth has slowed, and vacancy rates have risen (PSRC 2003b; FDIC 2003). Current economic conditions reflect this downturn. Unemployment in the Seattle-Bellevue-Everett area was 6.6 percent in April 2003, compared to 6.4 percent for King County, 7.3 percent for Washington State, and 6.0 percent for the United States (Washington State Employment Security 2003).

¹ This discussion of the affected environment is based on analysis prepared by the Puget Sound Regional Council (PSRC), the Federal Deposit Insurance Corporation (FDIC), and the real estate firm of CB Richard Ellis.

Forecasts of when the regional economy will return to pre-recession levels are cautious (PSRC 2003b). Estimates predict that the central Puget Sound region will experience very slow job growth in 2003 and may not fully recover to pre-recession growth rates until 2005. Unemployment rates may continue to increase due to an increased number of workers actively looking for jobs (PSRC 2003b). Job cuts in the aerospace and high tech sectors have increased unemployment rates in Seattle, Tacoma, and Vancouver. Current economic conditions reflect the struggle of the economy to recover with a weak labor market and continued loss of jobs.

4.4.1.1 Segment 1: Ballard Segment

Economic activity in the Ballard Segment consists of a mix of commercial and industrial activities. There are a number of retail chain stores, such as Safeway, QFC, Denny's, and Walgreens, as well as smaller restaurants (such as Quizno's and Wendy's), stores, and shops. The southern end of the segment has a high concentration of industrial activities and is a part of the Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) and the working waterfront along the Ship Canal. There is also an undeveloped site that is part of the Seattle Central Community College Maritime Training Center to the east of 15th Avenue NW. The businesses located within the Ballard Segment, as well as the other segments, are discussed further in Section 4.3, Land Use and Neighborhoods.

4.4.1.2 Segment 2: Interbay/Magnolia Segment

The Interbay Segment includes an urban industrial center with a mix of businesses in a commercial/manufacturing core. Maritime uses, light to heavy manufacturing, and warehousing characterize much of the land use along the segment. Economic activity in the Interbay area includes Fishermen's Terminal, dry docks, and boat repair facilities. Other businesses in the area include retail, services, and offices. The Interbay Athletic Complex (golf course and driving range) is also located along the Green Line alignment in the Interbay area. The potential site of the Interbay Operations Center alternative is located on a parcel of approximately 7.5 acres that is currently occupied by the Northwest Center.

4.4.1.3 Segment 3: Queen Anne/Seattle Center/Belltown Segment

The economic activities along the Queen Anne/Seattle Center/Belltown Segment include commercial, office, retail, high-density residential, and recreational enterprises. The Seattle Center is located along the Green Line alignment in this segment. The Seattle Center hosts many of the city's most important arts and cultural venues and it has a substantial number of business and organization clients operating within the Seattle Center campus, making it a unique economic activity area within the City of Seattle. The Belltown area is characterized by commercial office, retail, residential, and entertainment uses.

4.4.1.4 Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment includes Seattle's central business district and is the economic center of the city and much of the Puget Sound region, with the highest concentration of employment in the state. The Downtown Urban Core and Seattle Commercial Core also comprise the highest concentration of retail and commercial activity areas in the city. Local, regional, and federal government offices are located along the Downtown Segment of the Green Line alignment.

4.4.1.5 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The SODO Segment includes the Pioneer Square and International Districts, as well as an industrial/manufacturing district south to the Duwamish Waterway. The Burlington Northern Santa Fe (BNSF) Railroad tracks traverse the west side of SODO near the Alaskan Way Viaduct, and the region's primary

port and shipping facilities are located in the Port of Seattle terminal. Land use includes warehousing and distribution, railroads and terminal facilities, light manufacturing, parking, and mid-rise offices. There are also some retail, convenience store, and restaurant uses. The dominant facilities in the area are King Street Station, Union Station, the Seahawks Stadium, the Stadium Exhibition Center, Safeco Field, SODO Center, and the Seattle Public Schools administration building (the John Stanford Center for Educational Excellence).

4.4.1.6 Segment 6: West Seattle Segment

West Seattle is a largely residential area in the southwest quadrant of Seattle, and much of the economic activity of the area is generated within retail business centers at Alaska Junction and Morgan Junction. Industrial and manufacturing activity is concentrated in the Port of Seattle and the Duwamish Waterway manufacturing area located by the West Seattle Bridge. The other dominant industrial use along the West Seattle segment is the Nucor (formerly Birmingham) steel plant that occupies a 44-acre site south of the West Seattle Bridge.

4.4.2 Impacts

4.4.2.1 System-Level Impacts

Direct Economic Impacts

System-level impacts discussed below include long-term transportation benefits, changes to employment, labor and business income during construction, local tax revenues, and the localized impacts of property acquisition by segment on displaced businesses.

Transportation Benefits Relative to Costs

A study of the benefits and costs of the Green Line—demonstrated that the Project will generate annual benefits of \$136 million (2002\$) from travel time savings, parking cost savings, reduction in accidents, and improved reliability (http://archives.elevated.org/docs/BCA_Report_Final_revised.pdf). The monorail will generate annual travel time savings of approximately 5.5 million hours which are valued at half of the average regional wage rate resulting in annual benefits of \$77 million. The reduced travel times and improved reliability of the monorail will induce some drivers to switch from cars to monorail and reduce their parking and auto operating costs. Together those savings are estimated at \$40 million per year. Monorail trains traveling on an elevated guideways are more reliable and have lower accident rates than cars or buses traveling on congested roadways. The improved reliability and safety of the monorail will generate benefits of \$19 million per year. These annual benefits are projected over the life of the project and compared to the costs of constructing and operating the system. The total benefits of the Project were estimated at \$2.1 billion and when compared to estimated costs of \$1.7 billion result in net benefits of \$390 million (2002\$). The Project was shown to generate net benefits across a reasonable range of assumptions regarding construction costs and future system usage.

Employment and Labor Income

Building the Green Line is expected to cost \$1.75 billion (in year of expenditure dollars) and take five years to complete. Funding for construction and start-up operations will come from a Motor Vehicle Excise Tax (MVET) of up to 1.4 percent levied on certain vehicles registered in Seattle. After the Green Line becomes operational, fare box revenues would generate additional funds for operation and maintenance. Although all construction funds would be generated through local resources, these funds will be spent over a shorter period of time than they would normally have been (as tax revenues will be used to support construction bonds), providing a short-term infusion of new capital into the regional economy. By approving the Seattle Popular Monorail Plan, voters elected to purchase public transit

construction over five years instead of other goods and services over 30 or more years. Construction of the Green Line would therefore result in an incremental increase in employment and income by concentrating expenditures within the five years of construction. Some of the increased employment during construction would be offset by the shift in spending required to pay the 1.4% motor vehicle excise tax.

In addition to the direct construction jobs resulting from construction of the Green Line, construction spending is expected to generate 1,100 direct jobs per year in sectors offering direct services to the Project and additional 1,000 jobs from multiplier effects in other sectors of the local economy. These jobs would end shortly after construction is complete. Construction of the Green Line would generate a direct labor income from construction of \$329 million. Construction employment and the resulting labor income have larger multiplier effects than other types of spending. The total labor income from the Project including multiplier effects (net of the effects from reduced spending due to MVET taxes) is projected to be \$474 million (SMP 2003).

Construction of the Green Line would increase construction spending in the region during a time when the local economy is suffering from weak demand. Indirect impacts of increased output, employment, and personal income are anticipated to result from increased sales by sectors of the economy that support the direct purchases of supplies, materials, and labor associated with construction. Beneficial impacts result from increased sales to the employees of the directly and indirectly affected industries as they spend their earnings.

After construction, the Seattle Popular Monorail Plan projects that operation of the Green Line would require a staff of between 117 and 174 workers and a total annual labor budget of between \$10.3 million and \$14.4 million.

Revenues to State and Local Government

The economic activity associated with the construction of the Green Line could increase the revenues from sales and Business and Occupation (B&O) taxes levied by state and local governments. The Seattle Popular Monorail Plan anticipates paying \$80 million in sales tax to state and local governments. In addition, all businesses involved in construction will pay B&O taxes totaling more than \$10 million. These increases in tax revenues to the City of Seattle may be somewhat offset by reductions in revenues associated with business relocation and conversion of property from private to public ownership.

Some businesses subject to acquisition may choose to close or relocate outside Seattle city limits. The number of businesses that would decide to close or move outside the city is expected to be low, given the availability of suitable properties for relocation within Seattle. For those businesses that do close or relocate outside Seattle, there would be an associated loss of business and occupation taxes and property taxes, and potentially sales taxes. At the high end of the range, depending on the alignment and station alternatives selected, the Green Line would need to relocate 83 businesses along the alignment. If 10 to 20 percent decided to relocate outside Seattle or close, B&O, sales taxes, and property taxes could be lost for eight to eighteen businesses, resulting in a very small percentage reduction in total City B&O taxes, particularly since the tax revenues from individual businesses and properties potentially affected are apportioned to government agencies at City, County and State levels, and would not represent a substantial reduction in government receipts. Similarly, the loss of paid parking meters, although overall an important source of revenue to the City, remains limited in its economic effect given the overall supply of metered parking throughout the City, and would not result in a significant fiscal impact to the City.

The purchase of property by SMP would shift some real property from private to public ownership and thereby reduce the property tax revenues on those parcels. At most, depending on the alignment and station locations selected, the Green Line would require the purchase of 186 parcels that generate property taxes of between \$2.0 and \$2.17 million per year. In 2002, King County property taxes totaled

\$1.6 billion for residential properties and \$734 million for commercial properties (2002 King County Department of Assessments Annual Report). The greatest potential loss in property tax revenue to local governments from property purchase is approximately one-tenth of a percent (0.1%) of the total property tax revenue in the county. As discussed later in the section on indirect economic impacts, over the long term, private property values near stations tend to increase 10 to 40 percent relative to other similar properties. This increase in property values would tend to offset losses in tax revenue from SMP's purchase of private property.

Localized Impacts on Business and Employment

Depending upon which combination of stations and alignment alternatives is selected, the Green Line could affect between 22 and 83 businesses, organizations, or agencies that employ an estimated 1,274 to 483 to 1,636 workers. The estimate includes businesses that would be directly acquired because of a loss of function, which would include substantial loss of access for customers or the business's property access, or the removal of dedicated parking considered essential to the business. Information per segment is described below, and more detailed information about business and job displacements is found in Table 4.4-1. Estimates of employees that could be displaced were made based on business usage and square footage using methodology that was determined to be appropriately conservative for this analysis.

During public scoping, comments indicated concerns that the presence of the Green Line would decrease local economic activity for businesses along the alignment because of loss of visibility for passersby, or the loss of access, parking, or increase noise, traffic, congestion, visual impacts or other factors. These characteristics were considered in the analysis of indirect economic impacts, Section 4.4.

Because of the high residential, commercial, and industrial vacancy rates that currently exist and with similar availability projected for several years, SMP expects to be able to relocate most businesses and residents as needed with minimal adverse impacts (CB Richard Ellis 2003a,b,c). Most relocations are expected to be accommodated within Seattle, avoiding long-term losses in sales and B&O tax revenue to the City of Seattle and county and state government entities. However, successful relocations may be difficult for some businesses that have special needs, such as specific zoning requirements or access to types of customers, such as water-dependent or water-related uses. Also, some business owners may choose to close the business instead of relocating, and individual employees are not protected from the loss of jobs. A few businesses may choose to either close or relocate outside the City, thus negatively affecting local tax revenues.

Segment 1: Ballard Segment

As shown in Table 4.4-1, impacts to commercial enterprises along the Ballard Segment would occur only for Alternative 1.1 (West Side of 15th) or 1.1(s) (West Side of 15th single beam) stations. Alternative 1.1 could require relocation of 8 to 15 businesses that employ between 52 and 93 workers. The businesses potentially affected by this alternative include retail, commercial, and fast food establishments, as well as a boat repair business. Construction of Alternative 1.2 (Center of 15th) would not displace any business or public enterprise.

The Preferred Alternative, a single beam configuration along the west side of 15th Avenue NW, would require the relocation of 13 to 14 employers with an estimated 96 employees.

Segment 2: Interbay/Magnolia Segment

Construction of the stations for Interbay Segment Alternative 2.1 (West Side of 15th/Center of Elliott) would require displacement of two to five businesses and an estimated 23 to 123 workers. Businesses in this area include retail/restaurant, commercial, and industrial establishments.

Construction of the stations for Interbay Alternative 2.2 (Center of 15th/West Side of Elliott) would require displacement of six businesses with an estimated 53 to 79 workers.

Construction of Alternative 2.1 with either a west bridge (2.1.1) or far west (2.1.2) bridge connection would result in a partial acquisition of Port of Seattle property that includes industrial and water access dependent business activities. Under Alternative 2.1.1 (West Bridge Connection), a ship repair business could need to be relocated. Given the limited supply of waterfront space and related siting constraints, relocating these activities and workers would be difficult. The City of Seattle and other comments have emphasized the value of retaining maritime industrial operations in this area. While the displacement of the business would not alter the viability of other maritime industrial operations, the displacement of the business and its employees, if it could not be relocated to another suitable property in the area, would be a significant adverse impact. For more information, please see Section 4.3, Land Use.

Construction of the Operations Center in the Interbay Segment, which has been identified as the Preferred Alternative, would displace the Northwest Center (a community services center on two parcels) that houses eight operational enterprises (one employer) with an estimated 187 on-site workers. There are also clients in training served by Northwest Center, of which approximately 38 are off-site and 143 are on-site. Northwest Center (as of early July 2003) has a total of 330 employees and clients on-site. Businesses on this site include firms that engage in document destruction, document microfilming, assembly and packaging, commercial laundry, janitorial and grounds maintenance, and small manufacturing. The Northwest Center uses the earned income from these businesses to support its nonprofit mission to “promote the growth, development, and independence of persons with disabilities through programs of education, rehabilitation, and work opportunity.” The Northwest Center provides services to over 500 people with disabilities each year. These parcels have a total of 266,500 square feet of office, industrial, and warehouse space (L. Pisconski, Northwest Center July 2003). Staff at the Northwest Center are currently investigating long-term options for the Center’s location so that it can best serve its clients, in decisions independent of the Green Line project.

The Preferred Alternative for the Interbay Segment – Alternative 2.1 along the west side of 16th Avenue W and 15th Avenue W and the center of Elliott Avenue W would displace four business operations and an estimated 85 employees. This would include the boat repair facility at Fishermen’s Terminal. The Interbay Operations Center, as noted above, would displace 8 operations and 187 on site workers.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

In the Queen Anne/Seattle Center/Belltown Segment, Alternative 3.1 (Seattle Center/Republican) would require displacement of three to eleven businesses and an estimated 146 workers. This includes a mix of retail and commercial uses. It also includes a small portion of the Fun Forest at the Seattle Center where fewer than five rides could need to be relocated and one or two rides might be displaced. It is also assumed that the removal of the existing Seattle Center monorail structure would also involve the displacement of the business and the loss of employment for the operator’s employees. While the operator would be eligible for compensation, relocation would not be possible.

Alternative 3.2 (Mercer) would require displacement of four to twelve businesses and an estimated 109 to 183 workers. Properties affected under Alternative 3.2 include a mix of retail and commercial uses. The existing monorail operations and employment would also be displaced as discussed for Alternative 3.1.

Alternative 3.3 (Thomas) would require displacement of eleven to fourteen businesses and 126 to 151 workers. Near Key Arena, the businesses displaced included the Sonics/Storm team shop. This alternative requires displacement of several businesses on Fifth Avenue, as well as surface parking lots in the area, and also includes displacing the existing monorail operations.

Alternative 3.5 (Second/Denny) would require displacement of 14 to 17 businesses and an estimated 116 to 142 workers. This alternative would affect the Spruce Building tenants and the Sonics/Storm souvenir shop near the Key Arena, as well as displacement of the existing monorail operations.

The Preferred Alternative for the Queen Anne/Seattle Center/Belltown Segment would displace four businesses and 61 employees. This includes a mix of retail and commercial uses, as described for Alternative 3.1, and small portion of the Fun Forest at the Seattle Center where fewer than five rides could need to be relocated and one or two rides might be displaced. SMP will strive to relocate the Fun Forest within the Seattle Center campus. The removal of the existing Seattle Center monorail structure would also involve the displacement of the business and the loss of employment for the operator's employees. While the operator would be eligible for compensation, relocation would not be possible.

Segment 4: Downtown Segment/Pioneer Square

Construction of Alternative 4.1 (West Side of Second) would require displacement of between 8 and 21 businesses and public entities that employ between 203 and 253 workers. Affected enterprises include a mix of retail and commercial uses, as well as the Federal Reserve Bank. Construction of the Fifth and Stewart 2 (Virginia) station (Alternatives 4.1 and 4.3) would include extending a pedestrian walkway to the Westlake Center. Given the increase in overall transit service ridership to the area to be provided by the Green Line, this option would be likely to maintain or increase the number of potential customers entering the Westlake Center and is therefore likely to increase economic activity in Westlake Center. In addition, the Center and its businesses would continue to be located within an urban area with considerable activity unrelated to the operation of the existing monorail. Patrons of the Westlake Center would continue to be able to access the center through a wide variety of means, just as they do today, including by the Downtown Seattle Transit Tunnel, surface transit, walking, bicycling or by private vehicle.

Alternative 4.2 (East Side of Second with Crossover) or Alternative 4.4 (East of Center of Second with Crossover) would require displacement of up to 10 businesses and an estimated 31 to 51 workers.

Alternative 4.3 (Center of Second) could require displacement of 21 businesses and public enterprises and an estimated 244 workers, including displacement of the Federal Reserve Bank for the proposed Madison 3 (Center) station.

The Preferred Alternative for the Downtown Segment (Alternative 4.1 along the west side of Second Avenue) would require displacement of 8 business and 228 employees, including the mix of retail and commercial uses described above for Alternative 4.1.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

None of the alternatives for the Weller/King or Safeco Field stations would require business displacements. Construction of the guideway alternatives would not directly displace any business or public enterprise, nor require the relocation of workers.

Construction of Alternative 5.1 (East Side of Third/Utah), Option 5.1.1 (Utah) with a Lander 1 (Northeast) station could displace four retail businesses and an estimated 54 workers. The Lander 4 (Utah) station could displace one business (Home Depot hardware store), and an estimated 196 to 300 employees. Under Option 5.1.2 (First Avenue S), loss of parking associated with the Home Depot could affect the store's ability to maintain a viable business at that location. The Lander 2 (Southwest) station associated with Alternative 5.1.2 would displace two businesses. As noted below in the discussion of the Operations Center, which also would displace the Home Depot, the City of Seattle as well as parties from the nearby area have indicated concerns about the loss of the Home Depot and its related tax revenues.

Construction of the Lander 3 (Diagonal) station for Alternative 5.2 or 5.2(s) (West Side of Third/Utah) would require displacement of five retail businesses that employ an estimated 38 workers.

If the Operations Center is located in the SODO area, it would require displacement of five businesses with an estimated 496 workers. Businesses on this site include industrial and retail activities, including Home Depot, Washington Chain Supply, Ederer Crane, All Metals Fabricators, and St. Vincent De Paul Society. Comments received, including from the City of Seattle, stated that the displacement of the Home Depot, a major employer and, as estimated by the City, a source of nearly \$10 million in tax revenue annually. The City's comments stated that a business and employment displacement of this scale was undesirable, and would be a significant adverse impact.

The Preferred Alternative for the SODO segment (Alternative 5.2(s), a diagonal alignment with single beam portions along the west side of Third Avenue S and Utah Avenue S with no SODO Operations Center) would displace five businesses with an estimated 38 employees. Businesses on the site include industrial, manufacturing and retail operations.

Segment 6: West Seattle Segment

As shown in Table 4.4-1, Alternative 6.1 (West Seattle I) if constructed along the entire West Seattle Segment would require displacement of up to 11 businesses with an estimated total of 63 to 81 workers. Construction of Alternative 6.2 (West Seattle II) along the entire West Seattle Segment would require displacement of 3 to 4 businesses with an estimated 17 employees. Construction of any of the guideway alignments for the West Seattle Segment would not require any relocation of businesses or public enterprises. Subsegment Alternatives 6.3(s), 6.4 and 6.4(s) would require no business and employment displacements. Subsegment Alternative 6.5 would displace five businesses, with an estimated 16 employees.

Construction of a new, monorail-only bridge over the Duwamish River would take two years and could cause a minor disruption to Port of Seattle terminal activities during this time, but this would be minimized through coordination with the Port of Seattle during design and construction.

The Preferred Alternative for the West Seattle Segment (a combination of alignment alternatives that would feature a single beam crossing over the West Seattle Bridge, single beam configuration north of the Nucor steel plant above SW Spokane Street to SW Avalon Way, 35th Avenue SW, SW Alaska Street, 42nd Avenue SW, and then a single beam configuration along the west side of California Avenue SW) would displace four businesses and approximately 31 employees.

Table 4.4-1. Business and Employment Displacement Impacts by Segment

		Employers	Estimated No. of Employees
Ballard Segment			
TOTAL	Alternative 1.1 - West Side of 15th	8-15	52-93
Guideway	West Side 15 th	--	--
Guideway	Alt. 1.1.1 West Bridge Option	1	4
Guideway	Alt. 1.1.2 Far West Bridge Option	--	--
Station	Crown Hill 1 (West, 85 th)	7	25
Station	Crown Hill 1A (West)	4	20
Station	NW 65 th 1 (West) and 1B	6	39
Station	NW 65 th 1A	4	32
Station	NW Market 1 (Southwest)	--	--
Station	NW Market 3 (Northwest)	1	25
TOTAL	Alternative 1.1 (s)	13	101
Guideway	Single Beam Configuration	--	--
Station	Crown Hill 1A (West)	4	20
Station	NW 65 th 1B (West)	6	39
Station	NW Market 3A (Northwest)	3	32
TOTAL	Alternative 1.2 - Center of 15th	0	0
Guideway	Center of 15 th Option	--	--
Guideway	Center of 15 th /East Bridge Option	--	--
Station	Crown Hill 2 (Center)	--	--
Station	NW 65 th 2 (Center)	--	--
Station	NW Market 2 (Center)	--	--
TOTAL	Ballard Preferred Alternative and 1.1(s)	13-14	96
Guideway	West Side of 15 th (single beam – 1.1(s))	--	--
Guideway	Alt. 1.1.1 West Bridge	0-1	5
Station	Crown Hill 1A (West)	4	20
Station	NW 65 th 1B (West)	6	39
Station	NW Market 3A	3	32
Interbay Segment			
TOTAL	Alternative 2.1 - West Side of 15th/Center of Elliott	2-5	23-123
Guideway	West Side of 15 th /Center of Elliott	--	--
Guideway	Alt. 2.1.1 -West Bridge Connection	1	22
Guideway	Alt. 2.1.2 -Far West Bridge Connection	--	--
Station	Dravus 1 (16 th)	1	38
Station	Dravus 1A (16 th)	1	10
Station	Dravus 1B	--	--
Station	Howe 1 (West)	1	--
Station	Howe 1A (Blaine)	2	40
Station	Elliott and Mercer 1 (Center)	1	23
Station	Elliott and Mercer 1A (Center)	1	23

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
TOTAL	Alternative 2.1(s) - Center of 15th/West Side of Elliott	4	85
Guideway	Single Beam Configuration	1	22
Station	Dravus 1B (Barrett)	--	--
Station	Howe 1A (Blaine)	2	40
Station	Elliott and Mercer 1A (Center)	1	23
TOTAL	Alternative 2.2 - Center of 15th/West Side of Elliott	6	53-79
Guideway	Elliott East Bridge Option	--	--
Station	Dravus 2 (15 th)	5	48
Station	Howe 2 (Center)	1	5
Station	Prospect 3 (West)	1	31
Station	Elliott and Mercer 2 (West)	--	0
TOTAL	Interbay Preferred Alternative	4	85
Guideway	West Side of 15 th /Center of Elliott (Alt 2.1)	--	--
Guideway	Alt. 2.1.1 West Bridge Connection	1	22
Station	Dravus 1-B (Barrett)	--	--
Station	Howe 1A (Blaine) -	2	40
Station	Elliott and Mercer 1A (Center)	1	23
TOTAL C-1 Operations Center (Preferred)		8	187
Queen Anne/Seattle Center/Belltown Segment			
TOTAL	Alternative 3.1 - Seattle Center/Republican	3-11	68-146
Guideway	Seattle Center/-NW Route	4	45
Guideway	Fifth Avenue N (Original East Side alignment)	3	60
Guideway	Fifth Avenue N (Revised center alignment)	--	--
Station	Seattle Center/Queen Anne 1 (North)	--	--
Station	Seattle Center/Queen Anne 1A (North)	--	--
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	60
Station	Seattle Center/Fifth and Broad 1A-	3	23
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	0
TOTAL	Alternative 3.2 – Mercer	4-12	109-183
Guideway	Harrison	--	--
Guideway	Mercer to Fifth	3	87
Station	Seattle Center/Queen Anne 1 (North)	--	--
Station	Seattle Center/Fifth and Broad 1A	3	23
Station	Seattle Center/Fifth and Broad 2 (Harrison)	3	10
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 3 (West)	6	73
TOTAL	Alternative 3.3 – Thomas	11-14	126-151
Guideway	Thomas	4	45
Station	Seattle Center/Queen Anne 2 (South)	3	20

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	60
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	1
TOTAL	Alternative 3.5 - Second/Denny	14-17	117-142
Guideway	Second/Denny	10	76
Station	Seattle Center/Queen Anne 2 (South)	3	20
Station	Denny 3	1	20
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	1
TOTAL	QA/SC Preferred Alternative	4	61
Guideway	Seattle Center/Republican	--	--
Guideway	Alt. 3.1 Northwest Route	--	26
Guideway	Alt 3.2 West of Center on Fifth	--	--
Station	Seattle Center/Queen Anne 1A (North)	--	--
Station	Seattle Center/Fifth and Broad 1A	3	23
Station	Belltown 1A (West)	1	12
Downtown Segment			
TOTAL	Alternative 4.1 - West Side of Second	8-21	203-253
Guideway	West Side of Second	--	--
	Alt. 4.1.2 -West Alignment Option B	--	--
Station	Fifth and Stewart 1 (Northwest)	9	40
Station	Fifth and Stewart 1A (West)	1	10
Station	Fifth and Stewart 2 (Virginia)	2	16
Station	Fifth and Stewart 2A (Virginia Center)	1	15
Station	Pike 1A (West)	10	20
Station	Pike 1B (West)	5	40
Station	Madison 1 (West)	1	172
Station	Yesler 1 (West)	1	1
TOTAL	Alternative 4.2 - East Side of Second with Crossover	10	31-51
Guideway	East Side of Second with Crossover	2	2
Station	Fifth and Stewart 3 (Lenora)	3	27
Station	Pike 2 (East)	1	1
Station	Madison 2 (East)	3	0-20
Station	Yesler 1 (West)	1	1
TOTAL	Alternative 4.3 - Center of Second	21	244
Guideway	Center of Second	7	14
Station	Fifth and Stewart 2 (Virginia)	2	10
Station	Pike 3 (Center)	10	40
Station	Madison 3 (Center)	1	172
Station	Yesler 2 (Center)	1	8

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
TOTAL	Alternative 4.4 - East of Center of Second	9	49
Guideway	East of Center of Second	1	--
Station	Fifth and Stewart 3 (Lenora)	3	27
Station	Pike 2A (East Center)	1	1
Station	Madison 2A (East Center)	3	0-20
Station	Yesler 1 (West)	1	1
Downtown Preferred Alternative		8	228
Guideway	Alt. 4.1		
Station	Fifth and Stewart 2A (Virginia Center)	1	15
Station	Pike 1A (West)	5	40
Station	Madison 1 (West)	1	172
Station	Yesler 1 (West)	1	1
SODO Segment			
TOTAL	Alternative 5.1 - East Side of Third/Utah	1-4	20-392
Guideway	East Side of Third/Utah	--	--
Guideway	Alt. 5.1.2 First Avenue S	0-2	0-196
Station	Weller/King Street 1 (Standard)	--	--
Station	Safeco Field 1	--	--
Station	Lander 1 (Northeast)	4	54
Station	Lander 2 (Southwest)	1	20
Station	Lander 4 (Utah)	0-1	0-196
TOTAL	Alternative 5.2 - West Side of Third/Utah	5	38
Guideway	West Side of Third/Utah	--	--
Station	Weller/King Street 2-(Event)	--	--
Station	Lander 3-(Diagonal) -	5	38
TOTAL	Alternative 5.2 (s)	5	38
Guideway	Single Beam configuration	--	--
Station	Weller/King Street Station 2	--	--
Station	Safeco Field 1	--	--
Station	Lander 3 (Diagonal)	5	133
TOTAL	C-2 Operations Center	5	496
TOTAL	SODO Preferred Alternative	5	133
Guideway	West Side of Third/Utah/5.2.2	--	--
Station	Weller/King Street 2- (Event)	--	--
Station	Safeco Field 1 with switch	--	--
Station	Lander 3- (Diagonal)	5	38
West Seattle Segment			
TOTAL	Alternative 6.1 - West Seattle I-	11	63-81
Guideway	West Seattle Bridge	--	--
Guideway	Alt. 6.1.1 West Seattle Bridge/Past Pigeon Point	5	0-16
Guideway	Alt. 6.1.2 West Seattle Bridge/To Pigeon Point	--	--
Guideway	Alt. 6.1.3 West Seattle Bridge/Southeast Side of Fauntleroy	--	--
Guideway	Alt. 6.1.4 West Seattle Bridge/Northwest Side of Fauntleroy	--	--
Station	Delridge 1 (26 th)	--	--

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
Station	Avalon 1 (Center)	3	45
Station	Alaska Junction 1 (42 nd /Edmunds)	1	11
Station	Alaska Junction 1A (42 nd /Edmunds)	1	9
Station	Morgan Junction 1 (West)	2	9
Station	Morgan Junction 1A (West)	2	9
TOTAL	Alternative 6.2 – West Seattle II	3-4	17
Guideway	New Bridge	--	7
Station	Delridge 2 (Andover)	--	--
Station	Avalon 2A (35 th) and 6.2.1 Alignment	1	--
Station	Avalon 2B (35 th) and 6.2.2 Alignment	2	--
Station	Alaska Junction 2 (44 th /California)	--	--
Station	Morgan Junction 2 (Center)	2	10
TOTAL	Alternative 6.3(s) - Delridge- North Subsegment	0	0
Guideway	Delridge- North Subsegment	--	--
Station	Delridge 3 (North of Nucor)	--	--
TOTAL	Alternative 6.4 - Andover/Yancy Subsegment (and 6.4(s) with no station)	0	0
Station	Delridge 1A (Delridge/Andover)	--	--
TOTAL	Alternative 6.5 - Genesee Subsegment	5	16
Guideway	Genesee Subsegment	5	16
Station	Delridge 4 (Genesee)	--	--
TOTAL	West Seattle Preferred Alternative	4	31
	Delridge Guideway and Station	--	--
	Avalon Guideway and Station	1	10
	Alaska Guideway and Alaska Junction 1 (42 nd /Edmonds)	1	12
	Morgan Junction 1A	2	9

4.4.2.2 Indirect Economic Impacts

Current economic conditions mean that the construction of the Green Line could have a positive overall impact on the local and regional economies. The project is anticipated to cost over \$1 billion in construction and related funding over the next five years and to increase demand for construction-related goods and services. As this money is introduced into the local economy, much of it will continue to circulate and create job opportunities as workers spend money on goods and services and recipients again spend money on other goods and services. Operation of the Green Line could also encourage tourism spending by providing an additional tourist amenity and providing easy access to other areas of the city and other tourist attractions.

Operation of the Green Line would have positive effects on many nearby businesses by improving public transit and providing new transit options for workers and by bringing new customers to different areas of the city. The Green Line would increase the net capacity of the transportation system in the Seattle area, thereby enhancing the overall capacity to conduct business. The Green Line would reduce travel time for some trips and increase predictability of travel time. Economic benefits of the project also include improved access to other regional job centers and public transportation, which could improve the ability

of workers to access a higher number of employers and could lead to less transportation spending for families who can reduce their dependence on private automobiles.

The Green Line could lead to increased commercial, industrial, and residential development within walking distance of the stations. However, the system could also interfere with views, decrease visibility of businesses, decrease parking, increase congestion, and restrict access. As discussed in 4.3, Land Use and Neighborhoods, indirect impacts to employment could result from partial displacements that affect parking supply, as well as losses in on-street parking that could result in reduced business activity. In addition, nearby businesses could be affected, either negatively or positively, as the guideway or station changes the community characteristics of the area.

A review of the literature regarding the effect of transit systems, including the existing Seattle Center Monorail and transit systems in other cities, finds that after construction is complete, the economic impact of transit, as reflected by property values, is generally favorable, although other local market factors continue to be the major driver for property values and economic utility. Property values are generally higher within one-quarter mile of transit stations, and a location premium often extends one-half mile from transit stations (Diaz 1999; RICS 2002; Interwest Property Services 2002; Cervero and Duncan 2002; SMP 2002a). As stated in Diaz 1999,

“Residential properties become more attractive because residents near rail have more convenient access to regional employment, retail, and cultural opportunities. Properties holding employment uses such as offices and industrial sites experience higher property values because such properties have increased access to a larger labor market. In fact, office properties demonstrate a larger property value increase compared to industrial sites because office buildings tend to cluster in more dense concentrations, allowing for the benefit of rail to be more acutely felt. Finally, retail properties often benefit from the fact that rail transit contributes to the concentration of activity and increases in pedestrian traffic in transit-accessible, pedestrian-oriented districts.”

Proximity to transit stations may not have a positive effect on property values where existing use of transit is low, or where transit stations are located in an area with heavy industry or close proximity of freeways to the rail tracks (Diaz 1999). An analysis of the Vancouver, British Columbia elevated SkyTrain light rail system found that “Generally, residential, commercial and office land values increase by 10 to 40 percent as a result of proximity to transit stations” (Interwest 2002).

Although very little of the literature on the effect of transit on economic activity addresses impacts between stations, that which does exist indicates that property values along transit lines are still higher than in surrounding communities, even between stations. Kenworthy and Newman (1992) found that while “freeways usually lower the value of much land along their routes, and disperse commercial developments to their ends... rail systems increase land values all along their routes, and concentrate commercial development (and compact housing) around stations.” A study conducted by SMP found that compared with Second Avenue, the area of Fifth Avenue where the existing Seattle Center Monorail guideway is located has a greater percentage of higher-grade Class “A” commercial properties and that the rents for all property types were higher (SMP 2002a). The study found that, “The commercial properties along the existing monorail route do not appear to have suffered loss of revenue or value as a result of their locations along the guideway” (SMP 2002a).

4.4.2.3 No Action Alternative Impacts

Under the No Action Alternative, the Green Line would not be built and the 1.4 percent Motor Vehicle Excise Tax would not be collected. These funds would remain in the hands of the individual taxpayer to spend on other goods and services over the next approximately 30 years rather than being spent on Green Line construction and operations over the short term. Under the No Action Alternative, no properties

would be acquired, avoiding direct impacts to City and King County tax rolls, businesses, or employment. Positive benefits of the Green Line also would not occur.

4.4.3 Mitigation

In addition to the relocation policy described above in Section 4.2, Displacements and Relocation, the SMP design team would seek input from business owners regarding guideway height, alignment, station layout, streetscape, access, and parking to minimize adverse economic effects of possible impacts to businesses immediately adjacent to stations or the guideway. Potential mitigation measures could include designs that maintain visibility of businesses, signage, replacement parking, and marketing or promotional assistance programs for an initial start-up period.

4.4.4 Significant Unavoidable Adverse Impacts

There are not likely to be significant unavoidable adverse impacts to the local economy (including employment, income, tax revenue, and business activity) as a result of constructing or operating the Green Line.

4.5 VISUAL QUALITY AND AESTHETIC RESOURCES

This section describes the character of the existing landscape, the potential visual impacts of the alternatives, and potential mitigation measures. Mitigation measures include ways to avoid or minimize visual quality impacts and ways to restore or enhance visual quality. Visual quality assessment acquires and evaluates information about the existing conditions and visual resources of the proposed project area, the visual characteristics of the proposed facility(s), and the people who will view the facility. The City of Seattle Comprehensive Plan, Land Use Code, and State Environmental Policy Act (SEPA) policies were referenced to identify visual resources. The assessment methodology used here is adapted from the Federal Highway Administration's Visual Impact Assessment for Highway Projects (FHWA-HI-88-054) manual. The FHWA methodology was developed on behalf of communities adjacent to proposed transportation projects to give adequate consideration to the potential visual impacts resulting from highway projects. It has become an accepted framework for describing and analyzing the subjective visual experience and for developing the context for those analyses.

Although not required, the FHWA methodology was used for this EIS because the Green Line would be a linear transportation facility, like a highway, with a similar range of issues. Project impacts are evaluated with respect to the visual conditions that currently exist. Impacts are also considered for views of and from the Green Line. Impact is determined in terms of three critical factors:

- **Visual Quality** is the value assessment of the existing visual experience to the public, and the change in quality expected after the proposed project. The visual impact assessment describes the existing and proposed landscapes in terms of the memorability or distinctiveness of the landscape and whether the landscape is a harmonious mix of elements, free of eyesores or elements that do not fit with the overall landscape.
- **Viewer Response** is analyzed in terms of viewer exposure and viewer sensitivity, or the expectation a viewer would have for a visual experience in a given area. These two elements work together. *Viewer Exposure* refers to the physical location of viewer groups, the number of people exposed to a view, and the duration of their view. This includes both monorail and highway users and people in the surrounding area. *Viewer Sensitivity* is the degree to which a viewer expects a particular visual setting in an area based on the existing environment and extent to which visual elements are important to the viewer. Viewer sensitivity is affected by factors, such as the activities a viewer is engaged in; the visual context; and the values, expectations, and interests of a group of persons or a person involved in a particular activity or context.
- **Visual Character** is defined by existing visual resources and elements, and the relationships between them. These relationships are typically described in terms of dominance, scale, diversity, and continuity. Character-defining visual resources and elements include:
 - Landforms: types, gradients, and scale
 - Vegetation: types, size and maturity, and continuity
 - Land uses: size, scale, and character of associated buildings and ancillary site uses
 - Transportation facilities: types, sizes, scale, and directional orientation
 - Overhead utility structures and lighting: types, sizes, and scale
 - Open space: type (e.g., parks, reserves, greenbelts, and undeveloped land), extent, and continuity
 - Viewpoints and views to visual resources
 - Water bodies, historic structures, and Downtown skylines

- Apparent grain or texture, such as the size and alternation of structures and unbuilt properties or open spaces of the landscape
- Apparent upkeep and maintenance

The City of Seattle's SEPA environmental policies, in particular SMC 25.05.675.P, provide authority for the preservation of views of character-defining visual resources and elements from significant public viewpoints, parks, scenic routes, and view corridors. For this visual assessment, the viewpoints and significant views given in the SMC 25.05.675 that could be affected by the Green Line alternatives are listed in Table 4.5-1. Some SEPA viewpoints, such as Kinnear Park, Lawton Park and Playfield, Kobe Terrace Park, Jose Rizal Park, and Soundview Terrace Park are not included in this table because either the Green Line cannot be seen from the location or the Green Line is a distant view. Seattle code also provides authority to protect views of the Space Needle from nine locations identified by a combined inventory of SEPA sites and additional public places around Elliott Bay. Scenic routes designated in the SMC 25.05.675 that are in or near the Green Line route, or that could be visually affected by the alternatives, are listed in Table 4.5-2.

Table 4.5-1. Viewpoints and Public Views That Could Be Affected by Green Line Alternatives (per SMC 25.05.675.P.2.a)

Visual Resource	Direction of View
Mount Rainier	Southeast
Cascade Mountains	East
Olympic Mountains	West
Downtown Skyline	Varies
Puget Sound	Varies
Space Needle	Varies
Ship Canal	Varies
Viewpoint	
Betty Bowen Viewpoint, Queen Anne	West toward Puget Sound
Kerry Park	Southeast to Space Needle
Admiral/Belvedere Viewpoint	Northeast to City of Seattle skyline
Ballard High School	Southwest and west
West Seattle Stadium Park	West (Greenbelt) and East (Cascades)

Table 4.5-2. SEPA Scenic Routes (per SMC 25.05.675)

Scenic Route	Resource
Ballard Segment	
15 th Avenue NW – S of NW Market Street to landfall at Interbay	Mt. Rainier, Ballard Bridge
Interbay/Magnolia Segment	
Magnolia Blvd W – W of 15 th Avenue W	Elliott Bay
Elliott Avenue W - between Magnolia Boulevard and Pike Street	Elliott Bay, Puget Sound

Table 4.5-2. SEPA Scenic Routes (per SMC 25.05.675) (continued)

Scenic Route	Resource
Seattle Center/Queen Anne/Belltown Segment	
Mercer Street - between Queen Anne Avenue N and Fifth Avenue N	Seattle Center
Fifth Avenue - between Mercer Street and Stewart Street	Seattle Center, Seattle Skyline
Denny Way - between Elliott Avenue W and Broad Street	Puget Sound
Broad Street - between SR 99 and Denny Way	Puget Sound
Downtown/Pioneer Square Segment	
Yesler Way - Alaskan Way to Lake Washington Boulevard	Puget Sound, West Seattle
SODO/Chinatown International District/Pioneer Square Segment	
S Jackson Street - between Alaskan Way Viaduct and Rainier Avenue S	Mt. Rainier, Puget Sound
Alaskan Way Viaduct/SR 99	Puget Sound, Seattle Skyline, Olympics
West Seattle Segment	
35 th Avenue SW	Seattle Skyline
SW Avalon Way	Seattle Skyline

4.5.1 Affected Environment

This section describes the existing visual context of the Green Line alternatives according to visual character, visual quality, and viewer response as defined above. This description is a four-step process: establish the visual limits, determine significant views to or from the project area, describe the visual context, and create simulations of the proposed facilities for the important views. This process establishes the baseline conditions and extent of the project's visual context. From this baseline, we can assess the potential change in visual resources due to the proposed project.

A tree inventory was performed to help define the project's visual context and get a rough estimate of how many trees were in the path of the alternatives. Trees along the proposed alternatives were counted, sized and identified, if possible, during site visits. All data are estimates since this was not a formal tree survey. Data for Seattle Center trees were provided by the Seattle Center and not the result of a physical inventory. Please refer to Appendix W from the DEIS for the inventory data. The approximate limits of the visual environment are defined by the geography and built and natural environments from which the project may be visible and vice versa. This area of reciprocal visibility is called a viewshed. The Green Line alternative alignments would pass through several viewshed areas with markedly different visual contexts. In open areas, such as the Ship Canal or through Interbay, the viewshed is the approximate extent of clear view. In built areas, such as Ballard, Belltown, or Downtown, the viewshed is a band two or three blocks wide centered on the alignment. Views may extend beyond the limits shown, but the viewshed diagrams are illustrative only and were simplified for graphical purposes. The viewsheds for the six segments of the Green Line are shown schematically in Figures 4.5-1 through 4.5-5 of the Draft EIS.

Based on the viewshed analysis, viewpoints were selected to illustrate views of the Green Line where substantial numbers of viewers and representative features of the proposed alternatives are present, and/or the visual quality of the view is high (Tables 4.5-3 and 4.5-4). Key views were identified through consultation with the City of Seattle, the State Historic Preservation Officer (SHPO) and Seattle Landmarks Board, and the Seattle Center. The selection process took Seattle's policies and regulations into account with regard to aesthetic and historic resources because there are cultural and historic resources throughout the 14-mile route.

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS)

Figure #	View Position	View	Resource	Station
Ballard				
M-1	15 th Avenue NW to SE	West guideway Alternative 1.1		
M-2	NW 85 th Street and 15 th Ave NW to SW	Station; Alternative 1.1		Crown Hill 1 (West, 85 th)
M-3	NW 65 th Street and 15 th Avenue NW to SW	Station; Alternative 1.1		NW 65 th 1 (West)
M-4	NW Market Street and 15 th Avenue NW to SE	Station; Alternative 1.1		NW Market 1 (Southwest)
M-5	NW Market Street and 15 th Avenue NW to SW	Station; Alternative 1.1		NW Market 3 (Northwest)
M-6	NW 83 rd Street and 15 th Avenue NW to SE	Station; Alternative 1.2		Crown Hill 2 (Center)
M-7	NW 65 th Street and 15 th Avenue NW to SW	Station; Alternative 1.2		NW 65 th 2 (Center)
M-8	NW Market Street and 15 th Avenue NW to SW	Station; Alternative 1.2		NW Market 2 (Center)
Interbay/Magnolia				
M-9	Driving over the Ballard Bridge	North to Ballard with new box girder Green Line bridge to one side, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-10	Fishermen's Terminal Memorial	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-11	Fishermen's Terminal Memorial	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.2 (Far West Bridge)	Ballard Bridge	
M-12	14 th Avenue NW Boat Launch	Ballard Bridge and box girder Green Line bridge, Alternative 1.2 (East Bridge)	Ballard Bridge	
M-13	14 th Avenue NW Boat Launch	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-14	Fishermen's Terminal Memorial	Ballard Bridge and arched Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-15	Fishermen's Terminal Memorial	Ballard Bridge and cable-stayed Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-16	Elliott Avenue W and W Lee Street	Guideways; Alternative 2.1		
Interbay/Magnolia (continued)				
M-17	W Dravus Street	Station; Alternative 2.1		Dravus 1 (16 th)
M-18	W Howe Street at 15 th Avenue W	Station; Alternative 2.1		Howe 1 (West)
M-19	Elliott Avenue W at Sixth Avenue W	Station; Alternative 2.1		Elliott and Mercer 1 (Center)
M-20	W Bertona Street	Station; Alternative 2.2		Dravus 2 (15 th)
M-21	Elliott Avenue W at W Republican Street	Station; Alternative 2.2		Elliott and Mercer 2 (West)
M-22	W Prospect Street and Elliott Avenue W	Station; Alternative 2.2		Prospect 3 (West)
M-23	Kerry Park	Elliott Avenue W guideways; Alternative 2.1		
Queen Anne/Seattle Center/Belltown				
M-24	W Harrison Street	Guideway along street; Alternative 3.1		
M-25	Sonics Shop to N	Station and guideway turning from W Harrison Street into Seattle Center; Alternative 3.1		Seattle Center/Queen Anne 1 (North)
M-26	Warren Street and Republican Street to E	Guideway; Alternative 3.1		
M-27	Middle of Founder's Court to S	Covered walkway along Republican Street, lawn and fountain area; Alternative 3.1		
M-28	Fisher Pavilion to N	Amphitheater, lawn and fountain, alley, Northwest Rooms; Alternative 3.1		
M-29	Near whale sculpture to NW	Enclosure of fountain room by guideway, tree border; Alternative 3.1		
M-30	Marion Oliver McCaw Hall café to SW	Bents, Copper beech and lawn; Alternative 3.1		
M-31	Kobe Bell to SE	Copper beech, curve into Memorial Stadium, alternative between south stands and Center House; Alternative 3.1		
M-32	Bagley Wright Theater lawn to SE	Guideway across lawn and fountain with Space Needle in background; Alternative 3.1		
M-33	Parking stall 50 for Bagley Wright to SSE	Guideway section and to lawn; Alternative 3.1		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-34	Concrete steps on west side of EMP, E side of Fun Forest, to NW	Guideway elevation change, alternative through Center House and south bleachers; Alternative 3.1.1		
M-35	SE corner of Space Needle Plaza to SE	Connections to Seattle Center from station; Alternative 3.1		Seattle Center/Fifth and Broad 1 (Southeast)
Queen Anne/Seattle Center/Belltown (continued)				
M-36	Fifth Avenue near Vine Street to S along Fifth Avenue	Guideway down center of Fifth Avenue with city skyline in background; Alternative 3.1		
M-37	Cadillac/Teatro Zinzanni parking lot on Bell Street and Fifth Avenue	Station and profile; Alternative 3.1		Belltown 1 (Center-West)
M-38	Cadillac/Teatro Zinzanni parking lot on Bell Street and Fifth Avenue	Station and profile; Alternative 3.2		Belltown 2 (Center-East)
M-39	Third Avenue looking E along Mercer Street	Guideway; Alternative 3.2		
M-40	First Avenue and Mercer Street, to E	Bents and guideway; Alternative 3.2		
M-41	Middle of Founder's Court to N	Covered entry of Court and Mercer Street guideway; Alternative 3.1		
M-42	Outside lobby of Marion Oliver McCaw Hall to N	Alternative 3.2 - Mercer		
M-43	Just north of Thomas Street on Fifth Avenue to the north	Alternative 3.2 - Mercer		
M-44	Just S of EMP to NE	Station and Alternative 3.2 – Mercer		Seattle Center/Fifth and Broad 2 (Harrison)
M-45	South along Fifth Avenue from near Vine Street	Guideway axis down W side of Fifth Avenue with existing Seattle Center Monorail; Alternative 3.2		
M-46	Mid-block between Fifth Avenue and Sixth Avenue at Bell Street, to W	Station and profile; Alternative 3.1		Belltown 3 (West)
M-47	Key Arena Plaza, N end to S	Station at First Avenue and Thomas Street and guideway onto Thomas Street; Alternative 3.3		Seattle Center/Queen Anne 2 (South)
M-48	Just N of International Fountain to S	Lawn, fountain, and Fisher Pavilion; Alternative 3.3		
M-49	NW corner of Fisher Pavilion to SE	Children's Theatre; Alternative 3.3 -		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-50	From just W of Fifth Avenue and Thomas Street entrance to W	Thomas alternative from EMP to Fun Forest Pavilion; Alternative 3.3		
M-51	E side of Space Needle Plaza to E	EMP entrance for monorail; Alternative 3.1.1		
M-52	Drop off on Denny Way by Pacific Science Center to SE	Station and Alternative 3.5 -		Denny 3
M-53	John Street and Second Avenue to N	Alternative 3.5 -		
Downtown/Pioneer Square				
M-54	Olive Street, Westlake Avenue, and Fifth Avenue to NW	Station, bents, historic buildings; Alternative 4.1	Times Square	Stewart and Fifth 1 (Northwest)
M-55	Second Avenue and Stewart Street to E	Historic buildings, guideway; Alternative 4.1	Sequoia, Josephinum	
M-56	Fourth Avenue, mid block between Stewart and Virginia Streets, toward Stewart Street	Historic buildings, profile of guideway; Alternative 4.1	Bon-Macy's, Mayflower Hotel, Times Square	
M-57	Virginia Street and Third Avenue to SE	Guideway profile, historic buildings; Alternative 4.1	Bon-Macy's, Securities Building	
M-58	Second Avenue near Union Street to N	Guideway and bents at Stewart Street and Second Avenue, historic buildings; Alternative 4.1	Josephinum	
M-59	Second Avenue near Stewart Street	Long view down Second Avenue to south, Alternative 4.1		
M-60	Same as 58	Same, Alternative 4.2		
M-61	Same as 58	Same, Alternative 4.3		
M-62	Pike Street and Third Avenue to W	Pike Place Market; Alternative 4.1	Pike Place Market sign	
M-63	Pine Street and Third Avenue to W	Pike Place Market; Alternative 4.1	Pike Place Market sign	
M-64	First Avenue and Cherry Street to E	Profile of guideway, historic buildings; Alternative 4.1	Hoge, Dexter Horton, Alaska Buildings	
M-65	Second Avenue and Marion Street, to NW	Bents crossing Marion Street, Madison 1 (West) station, guideway; Alternative 4.1	Federal Office Building	Madison 1 (West)
M-66	Yesler Way between Second and Third Avenues to W	Station; Alternative 4.1	Pioneer Square	Yesler 1 (West)
M-67	Second Avenue and Cherry Street to S	Station, guideway; Alternative 4.1		Yesler 1 (West)
M-68	Pike Street and Second Avenue to NE	Station, guideway; Alternative 4.2		Pike 2 (East)

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-69	Second Avenue and Marion Street to NE	Station, guideway; Alternative 4.2	Federal Office Building	Madison 2 (East)
M-70	Yesler Way and First Avenue, to E	Pioneer Square Pergola, station, base of Smith Tower; Alternative 4.3	Pioneer Square Pergola, base of Smith Tower	Yesler 2 (Center)
M-71	Second Avenue between Madison and Marion Streets, to NE	Station, guideway; Alternative 4.3	Federal Office Building	Madison 3 (Center)
M-72	S Washington Street between Occidental and Second Avenues S, to E	Guideway, historic buildings; Alternative 4.1		
Downtown/Pioneer Square (continued)				
M-73	Third Avenue and University Street, to W	Puget Sound, view corridor, profile of guideway, historic building, Seattle Art Museum and Benaroya Hall; Alternative 4.1	Puget Sound, Brooklyn Building	
M-74	Third Avenue and Spring Street, to W	Puget Sound, view corridor, guideway, station; Alternative 4.1	Puget Sound	Portion of Madison 2 (East)
M-75	Fourth Avenue and Marion Street, to W	Historic buildings on Second Avenue and Puget Sound in background; Alternative 4.1	Old Federal Building, Exchange Building, Puget Sound	
M-76	Fourth Avenue and Madison Avenue, to W	Puget Sound, view corridor, historic buildings, profile of guideway; Alternative 4.1	Puget Sound	
M-77	Fourth Avenue and Cherry Street, to W	Historic buildings on both sides of Cherry Street, Puget Sound; Alternative 4.1	Hoge, Dexter Horton, Alaska Buildings	
M-78	Fourth Avenue and Columbia Street, to W	Puget Sound, view corridor, guideway; Alternative 4.1	Puget Sound	
M-79	Fourth Avenue and Pike Street, to W	Pike Place Market sign; Alternative 4.1		
SODO/Chinatown International District/Pioneer Square				
M-80	Second Avenue Extension S, between S Main and S Washington Streets, to N	Alternative 4.1 - West Side of Second	Smith Tower	
M-81	Second Avenue Extension S and S Main Street, to S	Guideway; Alternative 4.1	King Street Station and other	

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-82	Yesler Way and Third Avenue, to S	Bents at Main Street, profile between King Street Station; Alternative 4.1	King Street Station	
M-83	Main Street and Fourth Avenue, to W	Guideway; Alternative 4.1	King Street Station and other	
M-84	S Jackson Street and Second Avenue, to E	Guideway; Alternative 4.1	Edge of King Street Station	
M-85	S Jackson Street and Fourth Avenue, looking W	Guideway; Alternative 4.1	King Street Station and other	
M-86	Seahawks Stadium parking lot, to NE	Guideway, Weller/King Station, elevated Second Avenue; Alternative 5.1	King Street Station	Weller/King Street 2 (Event)
M-87	Safeco Field	Station, guideway and overpass; Alternative 5.1		Safeco Field 1
M-88	S Lander Street and First Avenue S, to NW	Lander Station and guideway; Alternative 5.1		Lander 1 (Northeast)
M-89	S Lander Street and First Avenue S, to NW	Lander Station and guideway; Alternative 5.2		Lander 2 (Southwest)
SODO (continued)				
M-90	S Lander Street and Utah Avenue S, to S	Lander Station and guideway; Alternative 5.1		Lander 4 (Utah)
M-91	S Lander Street and Occidental Avenue S, to NW	Lander Station and guideway; Alternative 5.1		Lander 3 (Diagonal)
M-92	Beneath Alaskan Way Viaduct at S Hinds Street, to N	Flyover at Alaskan Way Viaduct looking N to city skyline; Alternative 5.1		
West Seattle				
M-93	Belvedere/Admiral Viewpoint, to SE	West Seattle Bridge and guideway; Alternative 6.2		
M-94	SW Andover Street between 26 th and 28 th Avenues SW, to SW	Station; Alternative 6.1		Delridge 1 (26 th)
M-95	SW Avalon Way and SW Adams Street, to NE	Guideway, view of downtown Seattle; Alternative 6.1		
M-96	SW Avalon Way and Fauntleroy Way SW, to SE	Station and guideway; Alternative 6.1		Avalon 1 (Center)
M-97	42 nd Avenue SW and SW Edmunds Street, to NW	Station and guideway; Alternative 6.1		Alaska Junction 1 (42 nd /Edmunds)
M-98	California Avenue SW and SW Brandon Street, to S	Guideway; Alternative 6.1		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-99	California Avenue SW and SW Morgan Street, to NW	Station and guideway; Alternative 6.1		Morgan Junction 1 (West)
M-100	Delridge Way SW and SW Andover Street, to W	Station; Alternative 6.2		Delridge 2 (Andover)
M-101	35 th Avenue SW and SW Oregon Street, to SW	Station and guideway; Alternative 6.2		Avalon 2 (35 th)
M-102	44 th Avenue SW and SW Alaska Street, to SE	Station and guideway; Alternative 6.2		Alaska Junction 2 (44 th /California)
M-103	California Avenue SW and Fauntleroy Way SW, to S	Station and tail tracks; Alternative 6.2		Morgan Junction 2 (Center)

Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS)

Segment	Figure #	View position	View	Resource	Alignment	Station
Ballard						
	1	Looking south along 15th Avenue NW from NW 77th Street; same location as Figure M-1	Preferred Alternative*: Alternative 1.1 (s) single beam		1.1(s)	
	2	Looking south along 15th Avenue NW (east side) from NW 67th Street	Preferred Alternative: Alternative 1.1 (s); NW 65th 1B (West) station with dual beam passing area		1.1(s)	NW 65th 1B (West)
Interbay/Magnolia						
	3	Looking southeast along Elliott Avenue W toward Mercer Street from west side of Elliott Avenue W	Preferred Alternative: Alternative 2.1 and Elliott and Mercer 1A (Center) station and platforms over Elliott Avenue W		2.1	Elliott and Mercer 1A (Center)
	4	Looking south along 15th Avenue W from Dravus Bridge	Preferred Alternative: Alternative 2.1 and Dravus 1B (Barrett) diagonal station and dual beam guideways		2.1	Dravus 1B (Barrett)
Queen Anne/Seattle Center/Belltown						
	5	Looking south along Fifth Avenue at Broad Street from northeast corner of Fifth Avenue and Broad Street	Preferred Alternative: Alternative 3.1.4 and Seattle Center/5th & Broad 1A station and platforms		3.1, 3.1.4	Seattle Center/5th & Broad 1A (Southwest)

* Preferred Alternative is also the Final Staff Recommendation.

**Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS)
(continued)**

Segment	Figure #	View position	View	Resource	Alignment	Station
Downtown/Pioneer Square						
	6	Looking south along Second Avenue from Columbia Street	Preferred Alternative: Alternative 4.1; Yesler 1 station, vertical to horizontal transition of guideways at station		4.1	Yesler 1
	7	Looking south along Fifth Avenue from north of Virginia Street	Alternative 3.2; guideways and emergency walkway		3.2	Fifth and Stewart 2A (Virginia-Center)
	8	Looking north along Second Avenue (west side) from Marion Street; similar to Figure M-69	Alternative 4.4; Madison 2A (East of Center) station, guideway, and walkways over sidewalk		4.4	Madison 2A (East of Center)
SODO/Chinatown International District/Pioneer Square						
	9	Looking east toward King Street station from Seahawks Stadium parking lot	Preferred Alternative: Alternative 5.2 and King/Weller Street 2 (Event) station, platforms, and guideway	King Street Station	5.2	King/Weller Street 2A (Event)
	10	Looking southwest along First Avenue from northeast corner of First Avenue and Lander Street	Alternative 5.1; Lander 2 (Southwest) station, platforms, and guideway	Correction to Figure M-89: missing bent	5.1	Lander 2 (Southwest)
West Seattle						
	11	Looking north from Dragonfly Terraces toward SW Andover Street and Longfellow Creek Greenspace	Alternative 6.1; Delridge 1 (26th) station, guideways and Longfellow Creek and buffer	Longfellow Creek & buffer	6.1	Delridge 1 (26th)
	12	Looking northwest along California Avenue SW toward Dawson Street	Preferred Alternative: Alternative 6.1.6 (s) single to dual track transition		6.1.6(s)	
	13	Looking north along 35th Avenue SW from SW Alaska Street	Preferred Alternative: Alternative 6.2.2; Avalon 2B (35th) station and center guideway		6.2.2	Avalon 2A (35th)
	14	Looking west from Pigeon Point	Preferred Alternative: Alternative 6.3(s); Delridge 3 (Nucor) station and guideways		6.3(s)	Delridge 3 (Nucor)

**Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS)
(continued)**

Segment	Figure #	View position	View	Resource	Alignment	Station
	15	Looking northeast along SW Yancy Street, from near 28th Avenue SW	Alternative 6.4; Delridge 1A (Delridge/Andover) station, guideways and Longfellow Creek	Longfellow Creek Greenspace	6.4	Delridge 1A (Delridge / Andover)
	16	Looking southwest along Delridge Way SW, from SW Andover Street	Alternative 6.5; Delridge 4 (Genesee) station and guideways		6.5	Delridge 4 (Genesee)
	17	Looking east along Genesee Street from near 35th Avenue SW	Alternative 6.5 guideways	West Seattle Golf Course	6.5	

The criteria for determining visual impacts for Visual Quality and Aesthetics differ from those under Cultural Resources. Visual Quality and Aesthetics uses a gradient from low to high impacts to assess the entire context and activities within an area. The assessment is based on the synthesis of a set of broad criteria that include pedestrian or motorist experience, panoramic or scenic views, overall quality of the area, scale and contrast between elements in the area, and other factors. Cultural/Historic impacts evaluation is necessarily a narrower definition and focuses on whether or not the view of the historic resource has been affected. The Green Line's potential effect on historic resources, including changes to their visual setting, is evaluated in more detail in Section 4.11, Cultural Resources.

Photographs were taken from the viewpoints to be used for computer simulations that visualize different Green Line facilities, such as guideways and stations. While the simulations are limited in their field of view, the visual analysis considers the entire field of view. The photographs do, however, provide an accurate representation of the scale of a structure in relation to other objects seen from the viewpoint. Although station designs are prototypes, the simulations show the conservative case of unadorned, large-footprint and large-envelope station structures. These simulations depict the likely maximum footprint and height of the station, whereas in reality, stations may not be the maximum size. The views and simulations from the Draft EIS are in Appendix M (found in Volume Three of the Draft EIS document). This appendix also includes six conceptual visualizations that represent how specific alternatives may look after appropriate design features are included, including treatment of stations, guideways, and special structures, landscaping, and public art. These conceptual design simulations have been included alongside the related typical simulation.

Appendix MM was created in response to public comment on the Draft EIS. It presents seventeen simulations and a small portion of the urban design studies that were conducted as part of the community involvement and design development processes. SMP has undertaken an extensive urban design process in cooperation with the City and communities. Some of Seattle's leading designers were selected with community input to help visualize how the monorail can be woven into the existing urban fabric, and how stations' potential to enhance communities can be maximized.

In addition to its comprehensive urban design process, SMP has committed to a public art program of up to six million dollars, representing approximately one percent of construction costs, which will be administered by SMP, with the assistance of a public art consultant. SMP intends for the artists' work to be highly integrated into the system through design collaborations among contractor, engineers, architects and artists. SMP's intent is to concentrate its art effort in the guideways by involving the artists in the design development of the guideways and adjacent areas. In addition, other art opportunities will be developed and carried out through design and construction. Artists may be selected to collaborate on

system elements with the goals of improving the aesthetics of the entire system. Design collaborations will continue through the design process.

Sixteen of the simulations in Appendix MM are new and one is an update of Figure M-89 in Appendix M of the Draft EIS. The urban design study sections include on-going draft conceptual designs for stations and streetscapes; shadow studies for Second Avenue in the Downtown segment; and a comprehensive urban design study entitled “Draft Urban Design and Landscape Study: System-wide Urban Design and Landscape Guidelines”. The City will use these draft guidelines as the basis to guide permitting of the Monorail. Appendix MM can be found in Volume Two of this Final EIS.

Segment 1: Ballard Segment

The topography in this segment includes a moderate southward slope consisting of the Crown Hill, Loyal Heights, and Whittier Heights neighborhoods and Ballard. At the base of this slope, a basin containing Salmon Bay and the Lake Washington Ship Canal separates Ballard from the north-facing slopes that comprise the Queen Anne and Lawton neighborhoods.

Urban development in the Ballard Segment is nearly continuous and consists of moderate-scale commercial development with parking areas along 15th Avenue NW and NW Market Street; warehouses, industrial buildings, and marinas along and near the waterfront; multifamily housing along arterials; and dense single-family neighborhoods to the east and west. At the south edge of this segment, the Ballard Bridge leads south to Interbay.

Vegetation in this segment consists primarily of street trees and minimal ornamental plantings in commercial areas. Open space is associated with Ballard High School, several elementary schools, and diverse residential plantings. Existing scale is moderate in commercial areas, moderate to large along the waterfront industrial area and around the larger retail buildings in the segment, and small in single-family neighborhoods. Views in this segment tend to be limited by the density of development, and are primarily to the south and east. Scenic views are available, including those of Mt. Rainier and neighboring Queen Anne, Phinney, and Magnolia Hills. The Ballard Bridge offers scenic views of the Olympics and the water-oriented development and activities along Salmon Bay and the Ship Canal. Limited views of the Olympic Mountains are available looking west along arterials, and the waterfront can be seen on some street ends.

SEPA viewpoints include Ballard High School, which has views from its south edge of Mt. Rainier, and Queen Anne and Magnolia Hills. 15th Avenue NW is a designated scenic route from NW Market Street to the south edge of the segment, including the Ballard Bridge. Views down 15th Avenue NW south of NW 65th Street are similar to those listed above for Ballard High School. Views from Ballard Bridge, a historic structure (see Section 4.11, Cultural Resources), consist of the Lake Washington Ship Canal to the east, Salmon Bay and the Olympic Mountains to the west, and surrounding waterfront development and activities.

Although scenic views are available in this segment, the aesthetic experience of pedestrians along the proposed Green Line alternative alignments in this segment is diminished by traffic, an abundance of parking lots, and the lack of landscape improvements typical in a vehicle-oriented environment. Additionally, commercial and transportation signage, signalization, street lighting, and overhead utilities create a moderate degree of visual clutter. As a result of these factors, viewer expectation in the segment is low to moderate.

Table 4.5-5 summarizes the major visual resources and viewers in the Ballard Segment.

Table 4.5-5. Existing Visual Resources – Ballard

Landscape Unit	Limits	Visual Character	Public Visual Resources
15 th Avenue NW - Loyal Heights/ Whittier Heights	NW 87 th Street to NW 67 th Street	Terrain: gentle slopes Vegetation: street trees, some commercial and yards Buildings: low-rise commercial, some homes, condos, apartments Transportation structures: signals, roadway, bus stops Overhead structures: signals, utilities, roadway and commercial signage Open space: none Visual scale: medium	Mid-distant views of Magnolia, Queen Anne, Phinney Ridge
15 th Avenue NW - Ballard	NW 67 th Street to NW 50 th Street	Terrain: gentle slopes Vegetation: street trees Buildings: low-rise and big-box commercial Transportation structures: signals, roadway, bus stops Overhead structures: signals, utilities, roadway and commercial signage Open space: none Visual scale: medium	Mt. Rainier Mid-distant views of Magnolia, Queen Anne, Phinney Ridge
Ballard Bridge	NW 50 th Street to W Emerson Street	Terrain: gentle slopes, floodplain Vegetation: volunteer and invasives Buildings: light marine commercial and industrial Transportation structures: Ballard Bridge, drawspan roadway, onramps Overhead structures: drawspan structure, some utilities Open space: Salmon Bay Visual scale: medium to large	Viewpoint/Park: 14 th Avenue NW Boat Ramp, Fishermen's Terminal Park/Historic: Ballard Bridge

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 2: Interbay/Magnolia Segment

The terrain along the alternative alignments through this segment consists of the relatively flat trough in which the Interbay area is located. This area is bounded on the east by the steep slopes of Queen Anne and by the equally steep slopes of Magnolia to the west. Greenbelts cover much of these adjacent slopes. Other vegetation includes modest ornamental plantings, plantings in the Interbay P-Patch, and the broad lawn areas of the Interbay Athletic Complex (see also Section 4.10, Parks and Recreation).

Urban development in this segment is nearly continuous, but not dense, and ranges broadly from small- and medium-scale commercial, to multifamily housing, to large-scale office buildings, warehouses, and waterfront grain elevators. Limited areas of single-family housing can also be found in this segment. At the south end of this segment, overpasses for both the W Galer Street and Magnolia Bridges run perpendicular to the corridor, leading to development along and near Smith Cove and the Magnolia neighborhood.

Surface roads in this segment vary in width from two lanes in mixed commercial/single-family residential areas to seven lanes, including a turning lane, on 15th Avenue W. A Burlington Northern Santa Fe (BNSF) track parallels the corridor's west edge and serves the industrial uses near Elliott and Salmon

Bays and Smith Cove. Existing overhead facilities are numerous, including street overpasses, light standards, large-scale sign commercial structures, electric distribution lines that serve industrial uses in this segment, and associated utility poles. At the Interbay Athletic Complex, netting and metal poles associated with a driving range are prominent visual features.

Existing scale is large along the industrial waterfront and in areas with office and multifamily residence structures, moderate in areas with commercial uses, and small in the limited areas with single-family houses.

Recent development in this segment includes large office buildings and multifamily developments on the south end of this segment, and office development in the formerly industrial area on Smith Cove, between W Galer and W Prospect Streets.

Views in this segment are limited by the steep slopes of Queen Anne Hill to the east and by industrial and warehouse buildings to the west. To the west, the slopes of Magnolia Hill can be viewed through much of this segment, and at the south end of the segment, partial views of Elliott Bay are available from a multifamily development at the toe of Queen Anne Hill. Elliott Avenue W is a designated SEPA scenic route, with views of the greenbelts of Magnolia and Queen Anne Hills, and very limited views of Elliott Bay that are framed by large-scale commercial and industrial development. SEPA-designated viewpoints include Bayview Playground, with southward views of Elliott Bay, and Soundview Terrace Park, with westward views of Elliott Bay and Magnolia Hill.

Because of the high level of transportation uses, the prominence of the street in the visual environment, the industrial nature of this segment, and the lack of landscaping and pedestrian amenities, the quality of the pedestrian experience is low throughout this segment and pedestrian activity is low. Viewer sensitivity is also low in this segment, with the exception of the Interbay P-Patch and Interbay Athletic Complex, where viewers' expectations of the enjoyment of open space result in a moderate level of sensitivity.

Table 4.5-6 summarizes the existing visual resources and viewers in the Interbay Segment.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Seattle Center is a major urban gathering place and attraction for local citizens and tourists alike. It occupies most of a six-block by five-block area (approximately 74 acres) on a gently rolling terrace carved out of the southern slope of Queen Anne Hill. The Center is part of a diverse neighborhood that includes single-family homes, small mid-rise apartment buildings, and a variety of small to large businesses. Parking lots and structures are available on Mercer Street and Fifth Avenue N, and limited on-street parking is available along First Avenue N, W Harrison Street, and nearby side streets. In the neighborhoods to the north and west of the Center and within the Center, there is abundant vegetation in the form of mature street trees, residential yards and gardens, and landscaping around business properties that adds greatly to the aesthetic appeal of the Queen Anne/Seattle Center neighborhood.

The approach to the Center along W Harrison Street climbs steeply to the east, from Elliott Avenue W to the Key Arena Plaza at First Avenue N. W Harrison Street is a two-way street with one lane for each direction and on-street parking on both sides of the street. Both sides of W Harrison Street have mature street trees with overhead utilities along the north side. Buildings are a mix of ages and mid-rise apartments and businesses. These apartment buildings are historic resources (please see Table 4.11-1 in the Cultural Resources section). Many of the newer buildings include parking garages at street level or underground, and most blocks have small parking lots in addition.

Table 4.5-6. Existing Visual Resources – Interbay

Landscape Unit	Limits	Visual Character	Visual Resources
16 th Avenue W	W Emerson Street to W Barrett Street	Terrain: flat, depressed below 15 th Avenue Vegetation: volunteer, invasive, some commercial and residential Buildings: medium-sized industrial, converted residential, commercial, church Transportation structures: W Emerson Street, roadway Overhead structures: W Emerson Street, utilities Open space: Interbay Athletic Complex Visual scale: small to medium	Fishermen's Terminal
Interbay	W Barrett Street to W Harrison Street	Terrain: gently sloping Vegetation: golf course, P-Patch, street trees Buildings: residential homes, condos, commercial, industrial Transportation structures: overcrossings, signals, roadway, bus stops Overhead structures: utilities, roadway signage, commercial signage Open space: Interbay Athletic Complex, Interbay P-Patch Visual scale: variable, mostly medium to large	Viewpoint/Park: Kinnear Park, Bowen Viewpoint

Viewer exposure in this segment is high because the Center is a destination point for recreation and is bounded by major thoroughfares (Broad Street, Mercer Street, and Denny Way). Local residents and people visiting the Center for passive recreation may have higher view expectations, because the environs and scenery are important aspects of their experience. Commuters and travelers along the main roads and Center visitors attending sports events, conferences, or special events may have lower expectations of and sensitivity to views.

The Seattle Center presents different views to each of the major streets and neighborhoods it fronts. Mercer Street (a SEPA scenic route) is lined with mature trees and is the theater boulevard for the Center. Mercer Street is also a major connector route with large-footprint, two- to four-story mixed-use buildings (Larry's Market, theaters), a large parking structure for the Center, and parking lots in a range of sizes. Fifth Avenue N is a tree-lined thoroughfare through a commercial and business zone. There are recreational open spaces and buildings (Skate Park, Polly Esther's, EMP), parking lots, the entrance to Memorial Stadium, and the existing Seattle Center Monorail. The EMP and existing monorail together set the visual stage for this corner, creating one of the most prominent and heavily used public entrances to the Center. Broad Street and Denny Way are major arterials with varying visual conditions. Near the Center, Broad Street is a wide boulevard with an openness that is due to the spaciousness of the Peace Garden, the height of the Space Needle, and the absence of tall buildings near the right-of-way. Denny Way is a major east/west travel corridor with high traffic volumes. First Avenue N is a one-way, urban neighborhood street with low-rise apartment and office buildings and street trees.

The Seattle Center is a pedestrian-oriented environment with a wide range of cultural and recreational activities, architectural styles, and landscapes. The street grid pattern of the surrounding neighborhoods partly continues as pathways and access roads within the Center and acts as an organizing structure for the diversity of landscapes, spaces, buildings, structures, activities, and artwork in the center. Inside the Center, Thomas and Republican Streets and Second Avenue N express the grid and define the major pedestrian avenues connecting the Space Needle and Fun Forest area to the International Fountain open space, and then to the neighborhoods. Republican Street, on the north side of the Fountain lawn, with its landscaping and rows of London plane trees, is a key area of the Center, both as a pedestrian experience and as seen across the lawn from Thomas Street. Thomas Street has a pedestrian-oriented character between Fifth Avenue and Second Avenue. West of Second Avenue, Thomas Street's character changes

from a civic quality near Sacred Heart Church and the Fisher Pavilion, to a working zone near the service entrance of the Key Arena and the Seattle Center Garage.

Buildings in the Center are diverse in size, age, and style, and serve a wide range of functions. The majority are three to four stories high, on rolling terrain, amid a matrix of mature trees. The few tall buildings are in the basin (Marion Oliver McCaw Hall) or on hillsides (Key Arena, Center House). From the interior of the Seattle Center, the tall structures that define the Seattle Center (Space Needle and Science Center Arches) are background features. The EMP with the existing monorail emerging from it, the Space Needle, and the International Fountain are dramatic, memorable features. Thomas Street, with its arcades, Children's Theater, and view across the Fountain green, provides a positive pedestrian experience. Five significant historic resources have been identified. For a discussion of historic resources in this segment, please refer to Section 4.11, Cultural Resources.

The landscape plantings in Seattle Center are also diverse in size, age, and design. There are several small courtyards and gardens with special plantings associated with certain buildings (e.g., Kobe Bell garden, Northwest Rooms' courtyard, Founder's Court). The street trees and the gardens in the Center create continuity between the landscapes of the Center and the surrounding neighborhoods.

The rolling terrain, structures, and buildings limit views within the Center, which tend to be along the streets. Memorial Stadium and the theaters enclose the fountain and lawn, but glimpses of Capitol Hill to the east and of Queen Anne Hill to the north are seen from Thomas Street and the Fisher Pavilion, respectively. Views of the signature buildings and structures of the Center are primarily available from Fifth Avenue N and Broad Street. From a distance, the Space Needle is a key physical and visual landmark on the Seattle skyline and is one of the city's most important icons. The Space Needle is partially visible from Bhy Kracke Park and nearly fully visible from Kerry Park, but the Green Line alternatives would not affect these views.

South of Denny Way, Fifth Avenue is predominantly mixed-use, two- to six-story residential and commercial buildings, with a few mid-rise (10 to 15 stories) apartments and hotels. Parking lots and garages are available on most blocks. Fifth Avenue here is a tree-lined, one-way street with parking on both sides and columns for the existing Seattle Center Monorail down the center. The existing Seattle Center Monorail is a significant part of Fifth Avenue physically and visually. Views of the upper portions of the Seattle skyline and the Space Needle are available from the east side of the street. Viewer exposure is moderately high because Fifth Avenue is a major connector street between Queen Anne and Downtown, and because of the existing monorail. Viewer groups are a mix of residents who will have higher expectations about surrounding views, visitors to businesses or friends in the area who will have moderate expectations, and travelers (bicyclists, motorists, transit riders) through the area who will have low expectations with respect to views. Visitors are likely to be pedestrians, and moving slowly enough to be interested in the quality of the visual environment.

There are no views of Puget Sound from Fifth Avenue at street level south of Bell Street. Fifth Avenue follows a broad ridgeline, and then drops below and to the east of the ridgeline around Bell Street. A corridor view of Puget Sound to the west is available from Vine Street. Corridor views of West Seattle and Bainbridge Island are available from Wall and Bell Streets. There are few visual distractions such as signs and overhead utilities. Traffic signals are at every intersection and Fifth Avenue is a major bus corridor.

The pedestrian experience is primarily that of street-level features. The existing monorail guideways act as a kind of linear cap that decreases the sense of scale differential between buildings and obstructs a portion of the views of upper floors of buildings on the side of the street opposite the viewer. The close spacing of the column supports and their placement in the center of the street make Fifth Avenue feel

narrower than it is. However, there are diverse architectural styles and materials and building ages. Decorative friezes, doorways, small balconies, paving patterns, and other features create a varied pedestrian-scale environment. There are several significant and historic resources on Fifth Avenue to Belltown.

Table 4.5-7 summarizes the existing visual resources and visual character in the Queen Anne/Seattle Center/Belltown Segment.

Table 4.5-7. Existing Visual Resources – Queen Anne/Seattle Center/Belltown

Landscape Unit	Limits	Visual Character	Visual Resources
Seattle Center and W Harrison Street		Terrain: rolling terrace and gentle slope Vegetation: street trees, park landscapes, street plantings Buildings: medium residential and commercial to large recreation Transportation structures: existing monorail, signals Overhead structures: light standards and utility lines, road signs Open space: surface parking, parks and courtyards/plaza Visual scale: moderate	Viewpoint/Park: Space Needle Park/Historic: Seattle Center, Statue of Seattle, Chief of Suquamish (Tilikum Place)

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 4: Downtown/Pioneer Square Segment

Stewart Street and Second Avenue in this segment are major thoroughfares through Downtown Seattle and its intensive commercial and business uses and large multifamily housing buildings. This area includes the Financial District, as well as Pike Place and Pioneer Square Historic Districts. From Fifth Avenue westward, the terrain rises slightly, and then slopes down from Second Avenue to the waterfront to the west and to the King Street Station area to the south. This segment contains a mix of newer high-rise commercial, business, and residential buildings and older buildings, many of which are historic. There is little undeveloped space left. Architectural diversity and quality are generally high, which, together with the large scale of the buildings, create an attractive upscale urban character.

At Stewart Street, the street grid rotates a few degrees from the Belltown grid so that the east/west streets remain perpendicular to the waterfront as it curves southward. Through this segment, Second Avenue is a major thoroughfare with three one-way (southbound) traffic lanes, parking lanes on both sides, and a bicycle lane on the east side of the street. Utilities are underground along Second Avenue and aboveground along Stewart Street. Traffic is controlled by signals at each block. Stewart Street also has overhead trolley wires for the buses.

Viewer exposure is high due to the large volume of people working, living, visiting, or passing through the area. The viewing population is a mix of residents, tourists, shoppers, commuters, people taking advantage of the cultural and culinary attractions in the area, and people who work in the area. Commuters, bicyclists, and travelers would have lower expectations about visual quality than others because they are focused on driving and traffic. The remaining viewers would have higher expectations about the visual quality of the environment either because their activities are elective or because they spend a great deal of time in the area.

There is a broad spectrum of businesses along Stewart Street and Second Avenue in this segment. Uses include high-rise hotel and residential (Westin on Fifth Avenue, the Josephinum at Stewart), the arts (Seattle Art Museum and Benaroya Hall), financial (Federal Reserve, various banks), retail (Nordstrom Rack, Bon-Macy's, Westlake Center), and restaurants. There are large multi-story parking structures and a few parking lots between Stewart and Union Streets, but south of Union Street, some of the new high-rises incorporate underground parking.

There is great diversity of architectural styles and scales and public spaces. South of Union Street, most buildings along Second Avenue are set back from the sidewalk right-of-way, creating wider public pedestrian walkways. Several buildings have arcades or plazas and open spaces (Museum Plaza Building, Broderick Building, Garden of Remembrance at Benaroya Hall, Washington Mutual Building sculpture plaza, the Federal Office Building plaza, the Wells Fargo Bank Plaza) that vary the character of the sidewalk environment. Building entrances are emphasized by either being recessed or covered with awnings. Entrances and windows frequently have decorative archways or panels. Commercial buildings usually have street-level windows for displaying exhibits or products.

Landscaping in this segment is urban and includes street trees from Union Street southward, several public plazas (including the Garden of Remembrance and Washington Mutual Building), and several plazas with planters. The triangle created by Stewart and Olive Streets and Fifth Avenue, called Times Square, is landscaped and has an eight- to nine-story redwood tree.

Most of this segment offers an interesting, vibrant, and engaging public experience. Architectural diversity and detailing, window displays, and varied public spaces create visual interest and variety in scenery. There is also a sense of openness created by the width of Second Avenue, the wide sidewalks, architectural open spaces, and the occasional low building between high-rises. The pedestrian environment is further enhanced by the occasional view down a street or across a low rooftop toward Puget Sound, West Seattle, and Bainbridge Island. Along the alternative alignments between Fifth Avenue and Union Street, there is a great deal of signage including very large neon signs and a two-story billboard in the parking lot between Pine and Stewart Streets.

At Second Avenue and Stewart Street, a view of Puget Sound and Bainbridge Island is available to the west. There is a view of Mt. Rainier looking south down Second Avenue. The Pike Place Market signs can be seen from Pike and Pine Streets. Views across Puget Sound are also available from Marion, Madison, and Spring Streets. The City of Seattle has provided regulations (Seattle Municipal Code 23.49.024) that require upper level setbacks on Marion, Madison, Spring, Seneca, and University Streets to limit the encroachment of building towers on the views of Elliott Bay and landforms to the west. Second Avenue is one-way heading south, and the Washington Mutual Tower is the tallest building in the view from the Stewart Street area. At Spring Street, the Smith Tower and the Vulcan building are key features in the view. Glimpses of the pergola and trees of Pioneer Square to the west are available from James Street and Yesler Way.

Table 4.5-8 summarizes the existing visual resources and viewers in the Downtown Segment. Please refer to Section 4.11, Cultural Resources, for a discussion of historic resources in this segment.

Table 4.5-8. Existing Visual Resources – Downtown

Landscape Unit	Limits	Visual Character	Visual Resources
Stewart Street	Fifth Avenue to Second Avenue	Terrain: gentle slope Vegetation: median planting with redwood tree Buildings: medium to large business and commercial Transportation structures: existing monorail Overhead structures: overhead wires for buses Open space: surface parking Visual scale: moderate to large (view from Second Avenue and Stewart Street)	Park/Historic: McGraw Square
Second Avenue	Stewart Street to Yesler Way	Terrain: gentle slope Vegetation: street trees, plaza gardens Buildings: large office, commercial and residential Transportation structures: none Overhead structures: utilities, light standards Open space: plazas, surface parking Visual scale: large	Viewpoint/Park: view corridors toward Puget Sound, Marion Street, Madison Street, Spring Street, Seneca Street, and University Street Park/Historic (partial listing): Times Square Building, Bon-Macy's, United Shopping Tower/Olympic Tower, Hadfield Building, Exchange Building, Puget Sound Bank, Josephinum Hotel, Doyle Building, Hoge Building, Broderick Building, Dexter Horton Building, Alaska Building, Smith Tower, Pioneer Square, Pike Place Market,

"Historic" refers to resources that are either eligible or listed on national or local historic registers. For a complete list, please refer to Section 4.11, Cultural Resources.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The terrain in this segment includes the southward slope in the southeast part of the Pioneer Square Historic District and the filled Duwamish tide flats. Urban development is extremely diverse, ranging from late nineteenth- and early twentieth-century buildings of the Pioneer Square Historic District, to Safeco Field and Seahawks Stadium, to the surrounding warehouse and industrial buildings of the SODO area. The area also includes multifamily housing and large-scale office buildings between the stadiums and the International District, and King Street and Union Stations. Transportation facilities and the stadiums are the key features of the landscape south of the King Street and Union Stations. I-90 off- and on-ramps are located at the north end of this segment, and the Alaskan Way Viaduct runs the length of this segment's west edge. The West Seattle Bridge connects the southwest part of this segment to the west-facing slope of West Seattle. Both industrial and passenger rail traffic is served by several sets of tracks that run in a north/south direction, and rail yards are located adjacent to both Safeco Field and the Alaskan Way Viaduct.

The width of surface streets in this segment varies from five lanes on Second Avenue in Pioneer Square, to seven in SODO. Existing overhead facilities include freeway light standards and sign structures, high-voltage transmission lines, harbor cranes, light standards, and electrical distribution lines. Existing tree cover consists primarily of street trees.

The visual scale of existing urban development is moderate to large in the Pioneer Square Historic District; very large in the vicinity of the Seahawks Stadium and Safeco Field, around the office buildings

to the east of the stadiums, and along the Alaskan Way Viaduct; and moderate to very large in the industrial areas of SODO.

Distant scenic views are limited in this segment by the scale and density of development. The Alaskan Way Viaduct, a designated SEPA scenic route, provides views of Elliott Bay, Puget Sound, the Olympic Mountains, Mount Rainier, and the Downtown Seattle skyline. The skyline can also be viewed looking north from much of the SODO Segment. Attractive foreground views of nineteenth- and early twentieth-century structures can be found by looking west from southeast Pioneer Square toward the heart of the Pioneer Square Historic District. To the east, Beacon Hill is visible across the valley. There are three historic resources in south SODO.

The aesthetic experience of pedestrians in this segment is influenced by several factors. In the southeast area of Pioneer Square, pedestrian activity is high. The maintenance of buildings varies, and parking lots and small-scale twentieth-century structures encroach upon foreground views that are experienced in much of the rest of the Pioneer Square Historic District. The mature trees in Pioneer Square create a pleasant environment and contribute significantly to the overall aesthetic appeal of the area. Near the stadiums, pedestrian activity is high, but primarily on special event or game days. The width of streets, the very large scale of most buildings, parking structures, and the large expanse of stadium-related parking lots are the prominent visual features. In SODO there is little pedestrian activity. The industrial nature of land use, broad streets, numerous parking lots, and signage for businesses are the key components of the visual experience of pedestrians.

Overall viewer expectations are greatest in southeast Pioneer Square, in the vicinity of King Street and Union Stations, and in the Opus and Vulcan building developments east of the stations.

Table 4.5-9 summarizes the existing visual resources and viewers in the SODO Segment.

Table 4.5-9. Existing Visual Resources – SODO

Landscape Unit	Limits	Visual Character	Valued Visual Resources
SODO	Yesler Way to S Horton Street/Alaskan Way Viaduct intersection	Terrain: Mostly level, with moderate slope at north edge of segment. Vegetation: minimal street trees and ornamental vegetation Buildings: commercial and industrial buildings, stadiums. Transportation structures: Alaskan Way Viaduct, Interstate on/off ramps, railroad tracks and rail yards, parking garages. Overhead structures: Alaskan Way Viaduct, Interstate on/off ramps. Open space: gathering spaces associated with stations, offices, and stadiums. Visual scale: moderate to very large.	Viewpoint/Park: Jose Rizal Park, Hing Hay Park Park/Historic: Pioneer Square Historic District

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 6: West Seattle Segment

The rolling terrain in this segment includes two high, steep-sided ridges, consisting of West Duwamish Greenbelt and Pigeon Point and the landmass on which the majority of West Seattle is located. The ridges trend north to south, and are separated at their northern ends by a basin occupied by the Youngstown neighborhood and Longfellow Creek green space. Extensive greenbelts with mature trees cover western slopes in this segment, extending into the Longfellow Creek basin. Away from the greenbelts, existing tree cover consists primarily of street trees, highly diverse residential plantings, and several wooded parks.

Urban development is almost continuous, ranging from the large-scale commercial and industrial buildings in Youngstown, to the dense single-family neighborhoods on the ridge tops, multifamily developments along arterials, and moderate-scale commercial centers along Fauntleroy Way SW and California Avenue SW. There are several historic resources in this segment. The West Seattle Bridge connects the north part of this segment to the warehouse and industrial buildings of the SODO area and leads to both SR 99 and I-5. Surface road widths vary from five or six lanes for arterial roads to three or four lanes in single-family residential neighborhoods. Existing overhead facilities include light standards, sign structures, and electrical distribution lines.

Existing scale is large along the West Seattle Bridge and in the industrial part of Youngstown, moderate in the neighborhood commercial centers and multifamily areas, and small in the single-family neighborhoods. Recent development in this segment has resulted in an increase in building size and scale. Development includes commercial and office development, and multifamily redevelopment that ranges in height from two to seven stories.

Views from within this segment tend to be to the east or west, from the sides or tops of ridges. Scenic views of the Downtown skyline, Puget Sound, Elliott Bay, the Olympics, the Cascades, and Mt. Rainier are available within this segment. Both the West Seattle Bridge and SW Admiral Way are designated as SEPA scenic routes. Although SW Admiral Way is not near the Green Line alternative alignments, the guideway structure may be visible to both pedestrians and motorists using this route. SW Admiral Way's visual resources include the viewpoint at Belvedere Viewpoint Park and several street end viewpoints.

The aesthetic experience of pedestrians varies greatly within this segment. Single-family residences are key visual features in Pigeon Point and in the residential parts of the Youngstown neighborhood. Generally, pedestrian activity is low, while the nearby large-scale industrial buildings in Youngstown are the prominent visual features. In the Fauntleroy Way SW/SW Alaska Street area, wide arterial streets, stand-alone retail businesses, and their associated signage and parking lots, are the key visual features. The small to medium scale, generally high level of maintenance, and relatively intact nature of the commercial district in the Alaska Junction area create the perception of a distinct neighborhood, the buildings and sidewalks of which integrate the pedestrian experience. In the California Avenue SW and SW Avalon Way areas, middle ground views up and down the street and occasional distant are available to pedestrians; however, the wide arterial streets and largely auto-oriented environment influence the overall pedestrian experience.

Table 4.5-10 summarizes the existing visual resources and viewer group characteristics in the West Seattle Segment.

Table 4.5-10. Existing Visual Resources – West Seattle

Landscape Unit	Limits	Visual Character	Visual Resources
West Seattle	S Horton Street/ Alaskan Way Viaduct intersection to California Avenue SW/ Fauntleroy Way SW intersection	Terrain: rolling Hills separated by Longfellow Creek Basin Vegetation: street trees, ornamental plantings, greenbelt vegetation Buildings: single and multi-family residential, commercial, industrial. Transportation structures: Alaskan Way Viaduct, West Seattle Bridge Overhead structures: Alaskan Way Viaduct, West Seattle Bridge Open space: West Seattle Stadium Park, Camp Long, Duwamish Head and Longfellow Creek Greenbelts, Delridge Playfield Visual scale: small to very large	Viewpoint/Park: Belvedere Viewpoint Park, SW Admiral Way and SW Stevens Street Viewpoint, West Seattle Golf Course and Recreational Area Scenic Routes: Fauntleroy Way SW, SW Avalon Way, Alaskan Way Viaduct, West Seattle Bridge, SW Admiral Way, California Avenue SW, Harbor Avenue SW, 35th Avenue SW

Viewer expectations tend to be highest in residential neighborhoods, which include the Delridge and Youngstown communities and SW Avalon Way, Erskine Way SW, and California Avenue SW areas. Viewer sensitivity is also high in the commercial district of Alaska Junction; and in parks, viewpoints, and scenic routes located within these segments.

4.5.2 Impacts

The following sections summarize the potential visual and aesthetic impacts of the Green Line alternative alignments, stations, and other facilities in each of the project segments. Simulations from selected viewpoints are referenced in the discussions below. As noted previously, these simulations depict the likely maximum station or guideway footprint and height and, in the case of stations, show a conservatively large envelope of station structures without design detail. The views and simulations are provided in Appendix M in the Draft EIS and in Appendix MM in this Final EIS.

Visual impacts are rated as low, moderate, or high according to the following definitions:

- **Low** contrast between scale or character of proposed facilities and the existing environment; viewer groups will not likely notice visual change or expect a scenic viewpoint. Minor changes in shadow levels or light and glare may occur.
- **Moderate** contrast between scale or character of proposed facilities is noticeable but not dramatic; viewer groups are somewhat aware of and sensitive to visual change. Noticeable changes in shadow levels or light and glare may occur.
- **High** contrast between scale or character of proposed facilities and existing environment; viewer groups are sensitive to visual change and expect attractive views or surroundings. Substantial changes in shadow levels or light and glare would occur.

The impacts to regional views from West Seattle, Magnolia, Beacon Hill, and Queen Anne Hill are expected to be low. In most cases, Green Line alternatives would not be readily distinguished from other elements of the visual context, and their effects at this scale were represented in the Seattle Popular Transit Plan Programmatic EIS. Views from Rizal Park and Kinnear Park were not simulated for the same reasons. The Green Line's potential effect on the visual setting of historic resources is evaluated in more detail in Section 4.11, Cultural Resources. However, most identified impacts to historic resources are visual and are considered as part of the overall assessment of visual impacts for each alternative and segment.

Shadow impacts throughout the corridor would vary with alignment orientation, guideway height, and height of surrounding trees or building. In general, higher guideways would produce a softer, more diffuse shadow than lower guideways. The structure of the emergency walkways between the guideways would cast an open, lattice-like shadow between guideway shadows. Light and glare impacts would usually be associated with stations and trains, from interior and safety lighting for the stations, and from interior lighting and headlights on the trains. Shadow, light and glare impacts for particular locations will be discussed in the sections below.

Some alternative alignments involve removing street trees; approximate quantities and species are noted in each segment description. For a list of trees affected by the Green Line alternatives, please refer to Appendix W, Tree Survey Backup Information.

Switches and tail tracks for storage of out-of-service trains have been identified in the discussions that follow, but these features are options and the final locations have not yet been determined.

4.5.2.1 Segment-Specific Impacts

Segment 1: Ballard Segment

In general, the Green Line is expected to result in low overall visual impacts in this area. Visual impacts could result from station and guideway structures, removal of existing buildings, removal or trimming of existing street trees, and the addition of a new bridge crossing of the Lake Washington Ship Canal. Impacts could include view limitations, light, glare and shadow, and visual contrast between proposed development and commercial areas, public open spaces, and the waterfront along the Ship Canal and Salmon Bay.

Alternative 1.1 (West Side of 15th). Guideway and station columns for this alternative would be located on the west side of 15th Avenue NW, within the existing parking lane of the street. The dual beam guideways for this segment would be arranged either vertically or horizontally, depending on the location and station type. The structure would be a prominent visual element of the immediate vicinity, especially for viewers on the west side of the street (Figure M-1, which can be found in Appendix M of the Draft EIS). The sidewalks and buildings on the west side of 15th Avenue NW would receive bands of shadow in the mornings. Shadows during these midday and afternoon periods would fall on the street and would be expected to have little impact on pedestrians and adjacent structures. Overall impacts from shadows would be low to moderate.

There are 140 to 160 trees that could be removed or trimmed along the west side of 15th Avenue NW to accommodate the guideway and columns. Species include red maple, linden, and sweet gum. Heights range from 10 feet (newly planted) to 40 to 50 feet (mature). Most of the trees are in pits or planting strips. For a detailed survey of trees along the Green Line alternative alignments, please see Appendix W, Tree Survey.

The Crown Hill 1 (West 85th) station alternative marks the beginning of this alternative and the north terminus of the Green Line. Located on the west side of NW 85th Street, the structure would displace several small-scale commercial buildings, and would be taller than remaining small to medium scale existing structures nearby. However, existing moderate to high-level impacts generated from the width of the street, traffic, overhead utilities, and existing commercial development would result in moderate to low station area impacts (Figure M-2, which can be found in Appendix M of the Draft EIS).

The NW 65th 1 station alternative would result in removal of several commercial structures on the southwest corner of the intersection of NW 65th Street and 15th Avenue NW. Because the scale, bulk and height of the proposed station would be similar to the existing structures, resulting impacts would likely be low to moderate (Figure M-3, which can be found in Appendix M of the Draft EIS).

The Crown Hill 1A station would be located southwest of 15th Avenue NW and NW 85th Street and would be a single platform terminus station. Impacts from this alternative would be similar to but less than those in the Crown Hill 1 Alternative described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1A (West) station would be in the same location as NW 65th 1 station, but would be vertically arranged to reduce property acquisition. The additional height of this building, relative to NW 65th 1 station, and the need to configure connecting guideways vertically, would contrast with the height and scale of adjacent structures. Impact levels from this alternative would be moderate.

The visual contrast between the station alternatives NW Market 1 (Southwest) and 3 (Northwest) and the surrounding area is expected to be low (Figures M-4 and M-5, which can be found in Appendix M of the

Draft EIS). Stations along the west side of 15th Avenue NW could create shadows similar to those described for the guideway described above.

Impacts to views along the alignment in this area are expected to be low. View obstruction would be intermittent as one travels down 15th Avenue NW because there are limited regional views along this part of the alignment. Because 15th Avenue NW is bracketed by commercial buildings and businesses, and bends at NW 65th Street, regional views are limited to a narrow view corridor that includes the Ship Canal, Interbay, Queen Anne, and Magnolia. South of NW 65th Street, where 15th Avenue NW curves, the Green Line would be aligned with the Ballard Bridge. Although views of the Ship Canal and Elliott Bay are currently not available at street level in this area, the elevated alignment of all Green Line alternatives would introduce panoramic views of each of these features for Green Line passengers.

Ballard High School, a SEPA designated viewpoint, is located on the northeast corner of this intersection. Existing views from ground level at the school are currently heavily affected by existing development, and viewers at this level would not be expected to experience either obstruction of views or contrast with the character of existing views. However, viewers from upper floors of the school might experience partial obstruction of views to the southwest, including the Ballard Bridge and Magnolia.

The moderate to large scale of the existing buildings along the southern portion of the Ballard Segment and the urban character of the area would result in low-level visual contrast with the Green Line. Four historic resources determined eligible for the NRHP would be affected by Alternative 1.1 (West side of 15th); however, visual quality and aesthetics impacts would be low because the area surrounding these structures is characterized by the transportation corridor and modern commercial and business development of 15th Avenue NW.

Alternative 1.1(s) (West Side of 15th single beam). The single beam configuration along the west side of 15th Avenue NW would have less visual quality and shade impacts than the dual beam configuration of Alternative 1.1 because the support structure would not have the overhead armature of the dual beam configuration (Figure MM-1, which can be found in Appendix MM of this Final EIS). Tree impacts would be the same as Alternative 1.1. Switches at the Crown Hill 1A, NW 65th 1B, and Market 3A stations would provide the transition between single and dual guideway configurations. The single beam arrangement would result in a more open quality along the west side of 15th Avenue NW and shading effects would be lower than with a dual beam arrangement. The narrower width, in comparison with dual beam guideway, would result in lower levels of impacts related to shadow, view obstruction, and potential contrast of the guideway structure with adjacent buildings and land uses. In the immediate area of switches, impact levels would be similar to but somewhat greater than those generated by the dual track guideway in 1.1.

The Crown Hill 1A station would be a single platform terminus station. Impacts from this alternative would be similar to but less than those in the Crown Hill 1 station described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1B (West) station would be a side platform station located southwest of 15th Avenue NW and NW 65th Street (Figure MM-2, which can be found in Appendix MM of this Final EIS). It would provide a dual beam passing area for the single beam configuration along this alignment. Switches would be located both north and south of the station to facilitate a transition from a single beam configuration to the dual beam passing area at the station and then back to a single beam configuration. The station would generate lower level impacts than other NW 65th 1 station alternatives on this site because of the smaller size of the station structure.

NW Market 3A (Northwest) would be a vertically arranged station connecting to vertical dual beam guideways. It would be located northwest of 15th Avenue NW and NW Market Street. A switch would be located north of the station to allow the transition from a single beam configuration to a dual beam configuration to serve the station. Although this station would be taller than other adjacent structures, existing moderate to high-level impacts from the 15th Avenue NW roadway and traffic, overhead utilities, and nearby moderately large-scale retail and multiple family housing structures would result in a low to moderate impact level.

South of the NW Market station the guideways would remain in a horizontal dual beam configuration to connect with a bridge crossing the Ship Canal.

Alternative 1.2 (Center of 15th). The height, bulk, and scale of project elements in this alternative would be similar to those in Alternative 1.1 (West Side of 15th). The chief difference between the alternatives is that columns in Alternative 1.2 (Center of 15th) would be located in the existing continuous center turn lane. The placement of the Green Line down the center of 15th Avenue NW would be a strong linear visual element for those traveling along the street. Although columns located in the center of the street could result in somewhat greater obstruction of views north and south from the street itself, the center placement would also have the affect of visually dividing the broad expanse of pavement created by the multiple arterial lanes on 15th Avenue NW. Morning shadowing on nearby sidewalks and properties would be less extensive than in Alternative 1.1 (West of 15th) on the west side of the street. However overall effects of shadowing would be greater than those from Alternative 1.1 because Alternative 1.2 (Center of 15th) would cast shadows on the west side of the street in the morning, and on the sidewalk along the east side of the street in the afternoons and early evening.

At Ballard High School, the center guideway in this alternative could result in a band of shadow being cast on the grounds and lower levels of the building when the sun is low on the western horizon. Additionally, the center location of the guideway could add incrementally to potential partial view obstruction compared to Alternative 1.1 (West Side of 15th). Platform stairs for the station could affect a few street trees near the Ballard Swimming Pool, but this would depend on the design.

Approximately 12 lindens may be removed or trimmed along the east side of 15th Avenue NW to accommodate the guideway and columns. Heights range from 10 feet (newly planted) to 25 feet. In addition, trees at Mike's Chili Parlor and the wooded shoreline adjacent to the bridge master's building east of the Ballard Bridge are outside the right-of-way but could be affected by the overhead guideways and columns.

Station alternatives for the center of 15th Avenue NW alternative would have a greater visual impact than Alternative 1.1 (West Side of 15th) due to the pedestrian platforms spanning the whole of 15th Avenue NW. Crown Hill 2 (Center), 65th 2 (Center) and NW Market 2 (Center) would all require platforms that go along both sides of the guideway, which would appear as short bridges across the avenue. NW Market 2 (Center) could have small station buildings on both sides of 15th Avenue NW with walkways extending over the sidewalks to the platforms (Figures M-6, 7, and 8, which can be found in Appendix M of the Draft EIS). In addition, the Crown Hill 2 (Center) station alternative would require a double crossover just south of the station, which would significantly increase the visual impacts due to the additional support and overhead structures. The overhead structures for the stations on the side of the street would shade the street throughout the day with a diffuse lattice-like pattern. Shading would be more intense, possibly continuous, for the center stations due to the greater overhead coverage. Visual quality and aesthetic impacts to historic resources would be the same as Alternative 1.1.1.

Preferred Alternative. Through the Ballard segment, the Preferred Alternative would follow the alignment of Alternative 1.1 (s) (West of 15th with single beam). The single beam configuration along the

west side of 15th Avenue NW would have less visual quality and shade impacts than the dual beam configuration of Alternative 1.1 because the support structure would not have the overhead armature of the dual beam configuration (Figure MM-1, which can be found in Appendix MM of this Final EIS). The stations that would be associated with the Preferred Alternative are Crown Hill 1A (West, 85th), NW 65th 1B (West), and NW Market 3A (Northwest). Switches at these three stations would provide the transition between single and dual guideway configurations, but are expected to be less massive than switches between two horizontal guideways. The single beam arrangement would result in a more open quality along the west side of 15th Avenue NW. The narrower width, in comparison with a dual beam guideway, would result in lower levels of impacts related to view obstruction, and potential contrast of the guideway structure with adjacent buildings and land uses. In the immediate area of switches, impact levels would be similar to but somewhat greater than those generated by the dual track guideway in Alternative 1.1.

The Crown Hill 1A station would be a single platform terminus station. Impacts from this alternative would be similar but less than those in the Crown Hill 1 station described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1B (West) station would generate fewer impacts than other NW 65th 1 station alternatives on this site because of the smaller size of the station structure.

The NW Market 3A (Northwest) station would have a switch located north of the station to allow the transition from a single beam configuration to a dual beam configuration to serve the station. Although this station would be taller than other adjacent structures, existing moderate to high-level impacts from the 15th Avenue NW roadway and traffic, overhead utilities, and nearby moderately large-scale retail and multiple family housing structures would result in a low to moderate project impact level.

Ballard Crossing. There are three possible designs for the Ballard Crossing Green Line bridge, each with different visual and aesthetic impacts: box girder, arch, and cable-stayed. Three different locations are also examined. All the guideway and bridge alternatives over the Lake Washington Ship Canal would introduce strong linear visual elements and would be evident parts of the view. The bridge alternative that is selected will become a visual landmark. For all alternatives, the Ballard Crossing would be substantially above the view of Ballard Bridge travelers, although piers and approaches to the new bridge would intermittently interfere with views (Figure M-9, which can be found in Appendix M of the Draft EIS). It would provide riders with expansive views of the Lake Washington Ship Canal, Salmon Bay, ships and fishing boats, the fishing terminal, Seattle Maritime Academy and Fishermen's Memorial, the Olympic and Cascade Mountains, Phinney Ridge, Queen Anne Hill, and Magnolia Bluff. The overall visual quality impact would be moderate. There would be an impact to the Ballard Bridge, a historic resource, but other existing linear elements that are prominent in the view, and the distance of viewpoints from most of the alignments would limit the resulting visual contrast.

Diffuse, narrow afternoon and early evening shadows would be cast onto the Ballard Bridge by Alternative 1.1.1 (West Bridge), Alternative 1.1.1(s) (West Bridge single beam), and Alternative 1.1.2 (Far West Bridge). Alternative 1.2 (East Bridge) would cast morning shadows on the Ballard Bridge. None of the bridge alternatives would cause obstructions to aerial navigation, so no lighting would be required by FAA regulations. However, the FAA still has the authority to require the addition of steady, red, low-intensity, directional lighting for aerial navigation at night. For the highest (300 foot) cable stayed option, the FAA could require a flashing, low-intensity red light on top of the bridge tower.

Alternative 1.1.1 (West Bridge) and Alternative 1.1.1(s) (West Bridge single beam) would both follow the west side of the Ballard Bridge (Figure M-10, which can be found in Appendix M of the Draft EIS) and Alternative 1.1.2 (Far West Bridge) would be approximately 200 feet further west, creating less visual presence and less shadowing on the existing Ballard Bridge (Figure M-11, which can be found in

Appendix M of the Draft EIS). Alternative 1.2 (East Bridge) would partially obstruct views of the Ballard Bridge from the 14th Avenue NW boat launch (Figure M-12, which can be found in Appendix M of the Draft EIS). However, overall impacts on the boat launch are not expected to be significant because the bridge would not contrast strongly with the bulk, scale, and visual character of surrounding existing commercial and industrial development. A small number of trees near the shoreline and in private lots to the north could be affected by column placement.

Alternative 1.1.2 (Far West Bridge) would alter the visual character of the existing views west to Salmon Bay and could partially obstruct views west to the Olympic Mountains from the existing Ballard Bridge. Alternative 1.1.2 (Far West Bridge) would have the greatest impact on views from Fishermen's Memorial due to the close proximity, greater height and length, and overall scale. This could alter the character of the existing visual environment, drawing attention from the culturally distinctive and texturally complex fishing related activities on the waterfront, and emphasizing the Green Line Bridge. Alternative 1.2 (East Bridge) is expected to have the lowest impacts on views of the Ballard Bridge and to be the least distracting from attractive views of waterfront activities and development.

Views by the boating public would be somewhat affected by the Ballard Crossing, but impacts are expected to be similar for all alternatives. Views of the Ballard Bridge for boaters could be partially obstructed under Alternative 1.1.1 (West Bridge), Alternative 1.1.1(s) (West Bridge single beam) and 1.1.2 (Far West Bridge) as boats move west or east along the Ship Canal (Figure M-13, which can be found in Appendix M of the Draft EIS). Views of the Ballard Crossing from residences on the northwest side of Queen Anne hill and from residences and public areas (e.g., Lawton Park) in northeast Magnolia would be moderately affected by bridge alternatives. Some distant views could be altered for locations on lower parts of adjacent hillsides, but given the distance of the bridge from view locations a low to moderate level of change should occur.

The arch bridge and cable-stayed bridge designs for Alternative 1.1.1 (West Bridge) are illustrated in Figures M-14 and 15 (which can be found in Appendix M of the Draft EIS), respectively, for comparison.

Table 4.5-11. Key Public Views – Ballard

Relevant View	Distance	Potential Impacts (identifies where possible view obstruction could occur)
Viewpoints		
Ballard High School	F, M	Guideways for center or west alternatives would be visible from the school but the view of Elliott Bay to the south would not be obstructed.
Scenic Routes		
15 th Avenue NW	V	Views from the street to Mt Rainier would be partially obstructed by alignment. Views from Ballard Bridge to Olympics, Salmon Bay and Lake Washington Ship Canal, waterfront, would be partially obstructed and/or altered.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

V view obstruction varies depending on location of the viewer.

Segment 2: Interbay/Magnolia Segment

Overall, the height, scale, and broad linear visual elements of the Green Line columns, guideway, and stations would not contrast strongly with the existing visual character of existing visual features in this segment (Figure M-16, which can be found in Appendix M of the Draft EIS). The scale and bulk of proposed stations would be about the same as much of the mixed multifamily/commercial development in the north end of the Interbay Segment. However, existing impacts from traffic on 15th Avenue W,

overpasses, rail-related development, parking lots, and a trend toward large-scale commercial and industrial development diminish the potential for visual contrast between proposed development and existing visual features. Along Elliott Avenue W in the south portion of this segment, proposed alignment alternatives would not contrast significantly with the size, bulk, or character of existing moderate to large-scale office, industrial and warehouse structures. Street trees would be removed or trimmed for either alternative.

Alternative 2.1 (West Side of 15th/Center of Elliott) would pass adjacent to the Interbay Athletic Center and the Interbay P-Patch located north of W Wheeler Street. While the Green Line's guideway is not expected to shade the Interbay Athletic Center, the west alignment may cast shade on portions of the P-Patch for a short time during clear mornings. Several historic buildings occur along the segment, most with minor visual quality impacts, but up to two would have the guideways pass overhead (see Section 4.11, Cultural Resources). Storage tracks at W Mercer Place and Elliott Avenue W and switches on both sides of the storage tracks would have a moderate visual impact but would not block views due to the existing railroad tracks and industrial buildings in that area.

Between 110 and 120 street trees could be removed or trimmed along the west side of Elliott Avenue W to accommodate the guideway and columns. Species include red maple, hornbeam, zelkova, purple plum, and sweet gum. Heights range from 10 feet (newly planted) to 40 to 50 feet (mature). Most of the trees are in pits or planting strips. Two small greenbelts along the Emerson-15th Avenue N interchange would be affected also due to tree and vegetation removal.

Shadow impacts for this alternative would be similar to those described for the Ballard Segment. Shadows in the morning would reach the west sidewalk of Elliott Avenue W and shadows in the evening would reach the east sidewalk of 15th Avenue W.

The Dravus 1 (16th) station alternative and platform would remove the QFC building and several trees (Figure M-17, which can be found in Appendix M of the Draft EIS). Shadow impacts would result from afternoon shade on 16th Avenue W.

The Dravus 1A (16th) station would not require the removal of any buildings since it is within the parking area for the QFC store. This station would have similar visual impacts to Dravus 1 (16th) with platforms extending over the sidewalk, but would have a smaller station house than Dravus 1. It would also remove existing buildings on West Dravus Street to the west. Shadow impacts would result from afternoon shade on 16th Avenue W and on the parking lot during the morning.

The Dravus 1B (Barrett) station would remove three small buildings and a few more trees than with only the guideway crossing the area but these buildings would be removed by the guideway for Alternative 2.1. The station would span the block between 15th and 16th Avenue W and cast shadows on 15th Avenue W during the afternoon and on 16th Avenue W during the morning. The station would be higher than the surrounding buildings and the structures it would replace.

The Howe 1 (West) station alternative would have low impacts because it would be in scale and not contrast with the surrounding commercial-industrial buildings (Figure M-18, which can be found in Appendix M of the Draft EIS).

The Howe 1A (Blaine) station over 15th Avenue W would span the southbound lanes of 15th Avenue W. A straddle bent with station columns in the center turn lane would be required in order to span 15th Avenue W. Shadow impacts would result from afternoon shade on 15th Avenue W and throughout the day on the southbound lanes under the platforms. However, the station would not result in a high degree of change or contrast given the surrounding large commercial industrial development.

The Elliott and Mercer 1 (Center) station alternative would have a moderate to high visual impact due to the platforms spanning the width of Elliott Avenue W between the two station buildings. The overhead structure of the platforms and emergency walkways would create shade throughout the day and a bridge over the roadway. The structures are expected to be in scale with and compatible with the commercial-industrial character of the area (Figure M-19, which can be found in Appendix M of the Draft EIS).

The Elliott and Mercer 1A (Center) station would have less visual impact than the Elliott and Mercer 1 (Center) because this alternative would not fully span Elliott Avenue W as station option 1 would (Figure MM-3, which can be found in Appendix MM of this Final EIS). The passenger platforms would reach over the northbound lanes only, to the guideway in the center of Elliott Avenue W. Shading would occur throughout the day on the northbound lanes. The guideways would transition from horizontal to a vertical arrangement at the station. This is not expected to result in additional visual quality impacts.

In response to comments received on the Draft EIS and ongoing engineering and design work, this alignment has been revised slightly to provide slightly better visibility for drivers turning onto 15th Avenue W with the addition of six feet of clearance between the column and the edge of the roadway.

Alternative 2.1(s) (West of 15th/Center of Elliott single beam). The EIS studied a single beam configuration that would result in less visual and shade impacts than the dual beam configuration of Alternative 2.1 because the support structure would not have the overhead armature of the dual beam configuration. Switches at W Mercer Place at Elliott Avenue W (south end) and just south of W Dravus street (north end) would provide the transition between single and dual guideway configurations. The single beam arrangement would result in a more open quality along the west side of 15th Avenue W compared to a dual beam arrangement. Tree impacts and visibility through the columns would remain the same as for Alternative 2.1, but shading would be less than 2.1, with only one guideway overhead.

The single beam configuration would include the Howe 1A (Blaine) station and would switch to dual horizontally arranged guideways for two blocks between W Blaine Street and W Armory Way. Tree impacts would be the same as for Alternative 2.1. South of W Mercer Place, Alternative 2.1(s) would switch to the iris configuration (dual vertically arranged guideways) as it approaches the Elliott and Mercer 1A (Center) station (Figure MM-4).

Alternative 2.2 (Center of 15th/West Side of Elliott). Visual quality impacts due to this alignment and the Dravus 2 (15th) and Howe 2 (Center) station alternatives would be similar to those for Alternative 2.1 due to similar scale and setting of the alternatives. The guideways over the sidewalks and platforms spanning the 15th Avenue W southbound exit ramp and 15th Avenue W, respectively, would change the visual character of the route for pedestrians and motorists. Buildings would be removed for the station alternatives (as discussed above by station) and the overhead platforms would shade the roadway during most of the day (Figure M-20, which can be found in Appendix M of the Draft EIS). The Prospect 3 (West) and Elliott and Mercer 2 (West) station alternatives would have less impact than other two stations because there are no overhead structures spanning the street (Figures M-21 and 22, which can be found in Appendix M of the Draft EIS). Shadow impacts would be afternoon shading of the sidewalk and roadway and would be similar to those described for Alternative 2.1 (West Side of 15th/Center of Elliott).

Considerably fewer street trees and wooded strips would be affected by this alternative. The wooded strips along W Nickerson would be affected by the guideways passing overhead and 15 to 20 street trees could be removed or trimmed. Visual quality impacts to historic resources would be similar to Alternative 2.1.

Preferred Alternative. Through the Interbay segment, the Preferred Alternative would follow the alignment of Alternative 2.1 (West of 15th/Center of Elliott) and would have the same visual quality,

shadow and tree impacts as that alternative. The stations that would be associated with the Preferred Alternative are Dravus 1B (Barrett), Howe 1A (Blaine) to be constructed in the future, and the Elliott and Mercer 1A (Center) options. This configuration would also include the C-1 Operations Center (see below).

The Dravus 1B (Barrett) station would remove three small buildings and trees. The station would span the block between 15th and 16th Avenue W and cast shadows on 15th Avenue W during the afternoon and on 16th Avenue W during the morning (Figure MM-4, which can be found in Appendix MM of this Final EIS). The station would also be higher than the immediately surrounding buildings or the structures it would replace.

For the Howe 1A (Blaine) station, when it is constructed in the future, a straddle bent with station columns in the center turn lane would be required in order to span 15th Avenue W. Shadow impacts would result from afternoon shade on 15th Avenue W and throughout the day on the southbound lanes under the platforms. The contrast would be low, given the commercial/industrial development and transportation-intensive uses in the area.

The Elliott and Mercer 1A (Center) station would have less visual impact than the Elliott and Mercer 1 (Center) because option 1A would not span Elliott Avenue W as option 1 would (Figure MM-3, which can be found in Appendix MM of this Final EIS). The passenger platforms would reach over the northbound lanes only, to the guideway in the center of Elliott Avenue W. The guideways would transition from horizontal to a vertical arrangement at the station. This is not expected to result in additional visual quality impacts.

Interbay Operations Center. Visual quality impacts would likely be low to moderate given the predominately industrial and transportation-intensive setting. The Interbay Operations Center alternative would be the largest element of proposed Green Line development in this segment, covering much of the triangular block between W Wheeler Street and W Armory Way. A guideway switch crossing W Armory Way into the south side of the Operations Center would increase the number of structures. Switches would also be required to connect to the guideway. Additional visual impact would result from the columns and guideways for a double crossover switch just south of W Emerson Street, if constructed for an Interbay Operations Center. Because the existing industrial environment in this area consists of a BNSF railroad yard, warehouse and industrial structures, and large expanses of parking for both the armory and industrial waterfront development, the Operations Center is not expected to contrast with its visual surroundings. The Operations Center would not displace existing moderate to large-scale structures along the west edge of 15th Avenue W. These existing structures would continue to largely obstruct views west from the road corridor, including views of the Operations Center, because the Operations Center would be downhill from 15th Avenue W.

Visual impacts due to the C-1 Operations Center alternative would be slightly higher than those associated with Alternative 2.1 without an Operations Center due to the addition of a switch and guideway turning onto W Armory Way to the Operations Center. However, the guideways would remain in the horizontal arrangement and reduce the visual impact due to the height of the vertical guideways for Alternative 2.1.

At the P-Patch near the Interbay Operations Center, street-edge vegetation could be removed or trimmed for columns, but the tree border inside the P-Patch is not expected to be affected. In early mornings, however, portions of the P-Patch could experience lattice-like shading. The P-Patch is on a plateau north of the proposed Operations Center and part of the view from the P-Patch to the south could be blocked by the top story of the center.

15th Avenue W/Elliott Avenue W is a designated scenic route. Currently, views west along this corridor are largely obstructed by large-scale industrial, warehouse and office structures. Additionally, overpasses, utilities, large commercial signage, and vehicular traffic impact views north and south from the above-mentioned roads. As a result, the Green Line alternatives would not be expected to affect existing scenic views or significantly alter the visual character in the Interbay Segment.

The Interbay Segment contains several designated viewpoints, including Soundview Terrace, Lawton Park, Betty Bowen Viewpoint, Kinnear Park, Briarcliff Elementary School, Bay View Playground, and Magnolia Elementary School. Proposed development would not be visible from several of these viewpoints (e.g., Soundview Terrace and Betty Bowen Viewpoint), and where the Green Line guideway or facilities would be visible from viewpoints, impacts to these resources would be minimal owing to the moderate to high level of existing visual impacts in this segment. A simulation was created for Kerry Park to illustrate the visual impact (Figure M-23, which can be found in Appendix M of the Draft EIS). Potential impacts of the public views are outlined in Table 4.5-12 below.

Table 4.5-12. Key Public Views – Interbay

Relevant View	Distance	Potential Impacts (identifies where possible view impacts could occur)
Viewpoints		
Soundview Terrace	M/V	Portions of the guideway would be visible within the Mercer Street right-of-way, but views south to the Downtown skyline and west to Puget Sound would not be affected.
Lawton Park	F/V	Views of the Ballard Bridge and Ship Canal from the path at the south entrance path to the park would be altered but not obstructed. All Green Line bridge options would be visible above the Ballard Bridge, with Alternative 1.1.2 (Far West Bridge) the most prominent.
Bowen Viewpoint	M/V	Portions of the guideway would be visible within the 15 th Avenue W right-of-way, but views west to Puget Sound and the Olympic Mountains would not be affected.
Kinnear Park	F/V	Portions of the guideway would be visible within the 15 th Avenue W right-of-way, but views west to Puget Sound and the Olympic Mountains would not be affected.
Briarcliff Elementary School	M/V	Portions of the guideway along 15 th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside.
Bay View Playground	M/V	Portions of the guideway along 15 th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside or views south of the Downtown skyline and Puget Sound.
Magnolia Elementary School	M/V	Portions of the guideway along 15 th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside or views south of the Downtown skyline and Puget Sound.
Scenic Routes		
Elliott Avenue W	F/V	Partial or intermittent view obstruction of terrain and buildings would occur due to the guideway columns as one drives along Elliott Avenue W.
Kinnear Park	M and B	Portions of the guideway for either Interbay alternative within the Seattle Center/Queen Anne 1 (North) station, 15 th Avenue W right-of-way would be visible from Kinnear Park, but views west to Puget Sound and the Olympic Mountains would not be affected.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

V view obstruction varies depending on location of the viewer.

B background (farther than 1 mile)

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Queen Anne/Seattle Center/Belltown Segment has four possible alignment alternatives and several station alternatives. This segment comprises several subsegments that could be combined in different ways.

For all alternatives, key public views have been considered in addition to the visual impacts listed by alternative below. A visual impact that applies throughout this segment is that panoramic views of significant visual resources that were not available before from these places would become available due to the elevation and path of the trains. Light and glare impacts throughout this segment would vary with location. Because of the low to moderate level of existing lighting throughout this segment, additional lighting from stations and the train itself could result in moderate increases in local ambient light levels. Glare would be expected to be low due to the limited level of reflective structures and would be reduced by appropriate design. Station area diagrams, created as part of the urban design studies for Alternatives 3.1 (Seattle Center/Republican) and 3.2 (Mercer), are shown in Figures MM-16 and 17.

Alternative 3.1 (Seattle Center/Republican) would follow the south edge of W Harrison Street between Elliott Avenue W and Queen Anne Avenue N. Guideway height would be comparable in height to most of the buildings. No views from the street would be obstructed, but the guideway would pass near the fourth and/or fifth floors of the mixed-use buildings along W Harrison Street and could come within 10 feet of some façades, depending on the setback (Figure M-24, which can be found in Appendix M of the Draft EIS). The guideways would pass over a brick apartment building (part of a group of buildings eligible for listing in the National Historic register) at the northwest corner of First Avenue N and W Harrison Street, avoiding the need to remove the building, but the structure would be visible from and directly over some of the units, increasing shading. See Section 4.11, Historic Resources, for additional discussion. Shadow impacts along W Harrison Street are likely to be low to moderate because the mid-rise buildings and existing street trees shade the street now, but removing tall trees would change the shadow patterns.

There are 34 street trees that could be removed or trimmed along the south side of the street. Species include London plane tree, purple plum, crabapple, and sweet gum and are planted in pits or planting strips. Heights range from 20 to 50 feet.

The western half of the Northwest Rooms would be removed to accommodate the Seattle Center/Queen Anne 1 (North) or 1A (North) station (Figure M-25, which can be found in Appendix M of the Draft EIS, and MM-18 and 19, which can be found in Appendix MM of this Final EIS). The selected station would have greater physical presence in the Key Arena Plaza than the buildings it would replace. Visual change at the Key Arena Plaza is expected to be high, but the station design could result in positive change by creating greater street appeal along First Avenue N and Republican Street. Either station could also create a stronger plaza space and provide more integration with the Uptown neighborhood business district because the existing Northwest Rooms present a blank façade to the north and west (See Section 4.11, Cultural Resources). Forty to 50 trees would likely be removed for the station, including trees from the Northwest Rooms courtyard and along First Avenue N.

The Seattle Center/Queen Anne 1A (North) station option would be similar in massing and height to the Seattle Center/Queen Anne 1 (North) option, but the lower levels of either station could be designed for retail, commercial, or other uses. Visual impacts for this area could be lower than those of the Seattle Center/Queen Anne 1 (North) station because the station may be more compatible with the neighborhood's commercial character. Along Republican Street north of the fountain lawn, Alternative 3.1 could have moderate to high visual and shade impacts (Figure M-26, which can be found in Appendix M of the Draft EIS) due to the removal of the mature trees along the south edge. About 20 mature London plane trees would be removed on the south side and 24 trees could require trimming on the north side. The shade provided by the Republican Street trees would no longer be available but trees could be replanted south of the guideway to recreate the shaded walk. The mixed tree border at Memorial Stadium would likely be affected by construction of columns.

The Center House and Memorial Stadium, both historic resources, would have visual impacts as discussed in Section 4.11, Cultural Resources. No views within the fountain-lawn area would be interrupted since the guideways would be 40 to 60 feet above street level, but the presence of the guideway and support columns along the north edge of the fountain lawn would alter the views within the Center (Figure M-27, which can be found in Appendix M of the Draft EIS).

Visual impacts from other significant viewpoints are expected to be moderate. Views across the fountain lawn would be altered by the presence of the guideway, but the guideways and columns would echo the form of the covered walkway and the porticos at the theaters. The guideway structure would create a visual enclosure around the north side of the fountain lawn (Figure M-28, which can be found in Appendix M of the Draft EIS) and from the whale sculpture toward Marion Oliver McCaw Hall (Figure M-29, which can be found in Appendix M of the Draft EIS). Views from outside the lawn area would not be affected because the guideways would be well above the pedestrian level and columns would be specifically located to avoid blocking circulation and view ways (Figures M-30 and M-31, which can be found in Appendix M of the Draft EIS). In particular, the view from the Bagley Wright Theater of the fountain and the Space Needle would be unobstructed (Figures M-32 and M-33, which can be found in Appendix M of the Draft EIS) by guideways or columns.

The visual impact from trains passing during festivals at the Seattle Center is expected to vary with the observer and the setting. The kinetic quality of the train overhead could be a positive dynamic during such events for some participants, but could be also be perceived as a distraction. The impact could be greater for gatherings that are quiet or contemplative in nature if the movement and sound overhead is distracting. However, the guideways would not block audience views at outdoor performance or event areas, including Memorial Stadium.

At the northern Fun Forest edge, Alternative 3.1 (Seattle Center/Republican) includes two options for the transition to Fifth Avenue. The existing monorail station and some attractions in the Fun Forest would need to be relocated, as discussed in Section 4.3, Land Use and Neighborhoods. The guideways in that area as seen from the EMP would become a prominent part of the view from EMP but overall could increase the openness of the surrounding area (Figure M-34, which can be found in Appendix M of the Draft EIS). Alternative 3.1.1 (Through EMP) would preserve the memorable view of a monorail through EMP, which was designed around the existing monorail; Alternative 3.1.2 (Around EMP) would not, as the Green Line would pass to the south of the EMP. The honey locust row between the stadium and Fun Forest could be affected, as would the rows of London plane trees along Thomas Street.

The straddle bents required to span Broad Street for either Alternative 3.1.1 (Through EMP) or 3.1.2 (Around EMP) would be a significant physical and visual presence in the area, similar to the existing monorail, but the guideways would be higher and would accommodate change from horizontally to vertically arranged guideways.

Whether Alternative 3.1.1 (Through EMP) or 3.1.2 (Around EMP) is selected in the area of the EMP, Alternative 3.1 –(Seattle Center/Republican) would turn southward to the east side of Fifth Avenue N. (original 3.1 alignment) or it would cross to the center of Fifth Avenue N to the Fifth and Broad 1A station (Alternative 3.1.3). Visual impacts here are expected to be moderate to high because the station alternatives being evaluated, one on either side of John Street, would be larger than existing buildings, which may need to be removed to accommodate the station (Figure M-35, which can be found in Appendix M of the Draft EIS). Both Fifth and Broad alternatives are designed as event stations for the Seattle Center and could have elevated pedestrian walkways for safe, efficient connection to the Seattle Center. In addition, storage tracks could be constructed just east of the station and, if constructed, could project 50 to 100 feet north of the station. Switch tracks could be constructed across Denny Way to transfer trains to the storage tracks. If a storage option is selected, two sets of guideways

(turnback/storage, if constructed, and mainline) would cross Denny Way. The storage tracks would increase the visual impacts, including shadows, scale, and visual clutter. Three 60- to 70-foot London plane trees would be removed for this station.

The Seattle Center/Fifth and Broad 1A station would be a triple-platform station (Figure MM-5, which can be found in Appendix MM of this Final EIS). Visual impacts would be high due to a crossover at the station and increased guideway separation to the north and south of the station. This station would be smaller than the Seattle Center/Fifth and Broad 1 (Southeast), but would have platforms spanning Fifth Avenue N, requiring straddle bents. Fifth Avenue N would be shaded during the middle of the day by the platforms. Scale models of the Seattle Center/Fifth and Broad 1 (Southeast) and 1A stations studying their relationship to the immediate environs are shown in Figures MM-20 and 21, which can be found in Appendix MM of this Final EIS.

Two historic resources in the Seattle Center would be affected by Alternative 3.1 (Seattle Center/Republican) because the guideways would pass close to them, altering their setting. However, visual quality impacts to the Memorial Stadium and Center House would be low to moderate because the monorail does not contrast or conflict with the theme-park nature of the immediate environment around these structures.

In Belltown, Alternative 3.1 would remove the existing monorail guideway to accommodate new columns and guideway beams for the Green Line (Figure M-36, which can be found in Appendix M of the Draft EIS). The prominence of the vertically arranged guideways would be comparable to the existing horizontally arranged monorail, but the guideways would be noticeably higher and the overhead guideways would be vertically separated. The structure would be a major part of the Fifth Avenue streetscape; however, the spatial quality for the pedestrian could be more open than exists today since the columns would be farther apart and the guideways higher than for the existing monorail. Removal of the mature trees that line Fifth Avenue through Belltown would result in noticeable changes in shading, since the trees along the west side of Fifth Avenue shade the street from noon through the afternoon. The street would feel more open, but loss of the trees would alter the existing, distinctive character of an older urban neighborhood.

If a vertical guideway configuration is used, the guideways would pass in front of third- and/or fifth-floor windows, instead of just the third floor as currently exists; a horizontal configuration would primarily affect one floor only. Views along Fifth Avenue toward the Space Needle and toward Downtown could be partially obstructed by the higher guideways and by station platforms and structures. Vertically arranged guideways could have different visual impacts from horizontal guideways along the alignment, and vertical stations could be more compact than the horizontal stations. Conceptual streetscape studies for Fifth Avenue are shown in Figures MM-23 and 24, which can be found in Appendix MM of this Final EIS.

The Belltown 1 (Center-West) station building would be on the west side of Fifth Avenue. Belltown 1A would be an elevator station, smaller than Belltown 1 but in the same location. Belltown 2 (Center-East) would be on the east side of Fifth Avenue. All of the proposed stations would be comparable in scale to the buildings along Fifth Avenue. However, the overhead platforms could be highly visible and would create shadowing on the street because they would reach to the middle of the street. Views of building facades and entrances could be partially obscured by guideway columns. The Belltown 1 (Center-West) station alternative would remove two buildings and a few mature street trees on the west side of Fifth Avenue (Figure M-37, which can be found in Appendix M of the Draft EIS, Figure MM-25, which can be found in Appendix MM of this Final EIS). Belltown 1A (Center-West) and Belltown 2 (Center-East) alternatives would not require removal of any structures (Figure M-46, which can be found in Appendix M of the Draft EIS). No historic resources are affected.

Alternative 3.2 (Mercer). Visual impacts are expected to be moderate to high, similar to Alternative 3.1, although the alignment would be on the north side of W Harrison Street. At the Key Arena plaza, the visual impacts would be similar to those for Alternative 3.1 because the Seattle Center/Queen Anne 1 station would be used. Tree impacts would be similar to those of Alternative 3.1. About 34 street trees, 20 to 55 feet tall, could be removed or trimmed along the north side of W Harrison Street. Species include London plane tree, purple plum, crabapple, and sweet gum and are planted in pits or planting strips.

Visual impacts along Warren Avenue N and Mercer Street are expected to be moderate to high with Alternative 3.2. The guideways would be comparable to most building heights on Warren Avenue and Mercer Street and to the widths of Warren (30 feet) and Mercer (54 feet). The guideway and columns would contrast with the theaters, but less so with the five-story parking structure across from Marion Oliver McCaw Hall (Figure M-39, which can be found in Appendix M of the Draft EIS). The spatial quality of the street could also be altered by the removal of mature existing street trees (to avoid interference with the guideways) and the position of one guideway over the sidewalk. Sixteen trees on the west side of Warren Avenue would likely be removed. They include London plane trees, scarlet oaks, and a madrone, all about 20 to 40 feet tall. Along Mercer Street between 30 and 40 London plane trees, 50 to 70 feet tall, would be affected.

Straddle bents and the guideway spanning Warren Avenue N, Mercer Street, and Fifth Avenue N and the guideway passing over these streets could have a significant impact on the view along Mercer Street, a SEPA scenic route (Figure M-40, which can be found in Appendix M of the Draft EIS). The presence of the Green Line on Mercer Street would also have moderate impact on views from within the Seattle Center theaters and courtyards. The guideways (and columns, depending on placement) could be glimpsed from Founder's Court (Figure M-41, which can be found in Appendix M of the Draft EIS) and from outside the lobby of Marion Oliver McCaw Hall (Figure M-42). Shade impacts on the Seattle Center theaters would be low because the guideway is north of them, and because the buildings and trees on the south side are tall and create shade across Mercer Street.

Visual quality impacts along Fifth Avenue N between Mercer Street and the Fifth and Broad 2 (Harrison) station alternative are expected to be moderate. The guideways and columns would be set back from the street edge by 20 to 30 feet, so there would be little impact on Fifth Avenue N. The apparent width of Fifth Avenue N and the tree canopies along both sides and in the center median would screen the structure from the more active west side of the street (Figures M-43, which can be found in Appendix M of the Draft EIS, and MM-22, which can be found in Appendix MM of this Final EIS). Shadow impacts would be low here because of the existing continuous tree canopy. There is a high diversity of structures on the west side of Fifth Avenue N, whereas the east side is open and with fewer buildings. The Fifth and Broad 2 (Harrison) station (Figure M-44, which can be found in Appendix M of the Draft EIS) would remove one building. This station would be directly east of the EMP and could be similar in height to the EMP, which could obstruct some views of this notable building. These probably would have no impact to street trees.

Alternative 3.2.3, a modified alignment for Alternative 3.2, would involve guideways separating to the east and west sides of Fifth Avenue N and would connect to the Fifth and Broad 1A station identified in Alternative 3.1 above. The separate structures would be more visible from Seattle Center grounds, but the overall visual quality impacts are expected to be similar to the original Alternative 3.2 and Alternative 3.1.

In Belltown, Alternative 3.2 (Mercer) would travel on the west side of the street with two options: one to remove the existing monorail's columns and guideway beams and another to retain them. Both would have high visual change, but Alternative 3.2.1 (Remove existing monorail) could result in a positive

change because the overhead view from the center of Fifth Avenue would be opened. Shadow impacts could be similar to existing because the Alternative 3.2 (Mercer) configuration would be taller but closer to the buildings. Because the existing buildings along Fifth Avenue are taller than the planned Green Line guideway, shadow impacts would be limited primarily to morning and midday hours of the day.

Alternative 3.2.2 (Retain existing monorail) would have a high visual impact by virtue of having four guideways over Fifth Avenue (Figure M-45, which can be found in Appendix M of the Draft EIS). Views along Fifth Avenue to the Downtown skyline or the Space Needle would be obstructed more than they are now, and the view along the street would have more overhead congestion due to four guideways. Driving between the two rows of columns could be distracting and in walking under the four guideways one could feel enclosed. Views of building facades and entrances could be partially obscured by columns, which could affect the coherence of the streetscape. The west and east sides could become separate spatial zones.

A west of center alignment along Fifth Avenue was developed as a refinement to a west side alignment due to comments received on the Draft EIS. The guideways would be farther from the property line, increasing the distance between the trains and buildings. Fifty-five to sixty mature London plane trees (ranging 20 to 80 feet tall) on the west side of Fifth Avenue would be removed. A strip of sidewalk between Blanchard and Lenora Streets could be modified to include support columns, resulting in a slightly narrower street there. Shadow impacts would be more significant for Alternative 3.2.2 (Retain existing monorail) with four guideway beams overhead, but the change in shading would be moderate because trees currently shade the street. Replanting would also be less likely with two monorails on Fifth Avenue. Mitigation could include replanting with a shorter tree variety.

Belltown station alternatives Belltown 1 (Center-West), Belltown 1A (Center-West), and Belltown 3 (West) could be used for alignment Alternative 3.2. Belltown 3 (West) would be at the same location as Belltown 1 (Center-West) but would potentially remove five buildings instead of two (Figure M-38, which can be found in Appendix M of the Draft EIS). This station is expected to have less visual impact than the Belltown 1 and 2 stations because the platforms would not extend beyond the edge of the sidewalk. The narrowness of the crossover and the height of the lower platform would resemble a building awning and therefore would not result in a substantial change in spatial quality. The Belltown 1A station would have low visual quality impacts similar to those of the Belltown station alternative.

Alternative 3.3 (Thomas) would have moderate effects similar to Alternative 3.1 from Elliott Avenue W to First Avenue N along W Harrison Street. The alignment would curve southeast across First Avenue N toward the Sonics/Storm Shop at the south end of the Key Arena Plaza. At the south end of the plaza, the Sonics/Storm Shop and NASA building would be removed for the Seattle Center/Queen Anne 2 station (Figure M-47, which can be found in Appendix M of the Draft EIS). The design of the station could have a positive impact on the street character and plaza because it could provide for a more open character to the southwest.

The guideway along Thomas Street would have moderate to high effects, altering the open boulevard character of the street west of the Center House, as well as the setting of some of the buildings, particularly the Center House, which the Green Line would pass directly in front. Along Thomas Street, over 100 mature London plane trees, red oaks, katsura trees, and Norway maples would be removed or trimmed for the guideway and columns. The guideways would pass in front of Sacred Heart Church, the Center House, the Children's Theater, and the Mural Stage courtyard. The spatial quality of the street would be altered because the height of the proposed horizontally arranged guideways would be comparable to most building heights and to the width of Thomas Street. The columns and guideways would narrow the circulation corridor and place the guideways overhead.

The Thomas alignment west of the Center House would be partially visible from the fountain lawn area and the Mercer Street entrances (Figures M-48 and M-49, which can be found in Appendix M of the Draft

EIS). The guideways would be approximately mid-roof level near the church and about proscenium level at the Children's Theater and therefore would not significantly obstruct views of architectural detailing. The theater is set back far enough from the columns so that the entrance would remain visually distinct from the guideway structure and columns. The Center House, a historic resource, would experience adverse visual impacts, as discussed in Section 4.1, Cultural Resources. The Fun Forest would have low impacts. East of the Center House/Fun Forest, the Green Line could be visually compatible with the futuristic Space Needle and carnival character of this area (Figures M-50 and M-51, which can be found in Appendix M of the Draft EIS).

Visual impacts due to the addition of straddle bents required for the Fifth Avenue crossing would be similar to impacts from the existing monorail (Figure M-52, which can be found in Appendix M of the Draft EIS) or Alternative 3.1.

Alternative 3.5 (Second/Denny) from Elliott Avenue W to First Avenue N would have effects along W Harrison Street similar to Alternative 3.1 (Seattle Center/Republican). At the Queen Anne/Seattle Center 2 (South) station alternative, two historic buildings would have adverse visual effects from the structure and station in the vicinity (please refer to Section 4.11.2.1, Cultural Resources). In this alternative, the Seattle Center Pavilion (just west of the Fisher Pavilion) and the Blue Spruce Building would be removed to accommodate support columns, and two buildings and mature trees along Denny Way (a SEPA scenic route in this section) would be removed for columns and the station on Denny Way (Figure M-53, which can be found in Appendix M of the Draft EIS). Forty five to 55 red leaf maple, London plane trees, and redwoods would be removed along Second Avenue and Denny Way to Fifth Avenue.

Straddle bents and/or other special structures would be required for the curves at Thomas Street and Second Avenue N and at Second Avenue and Denny Way. These support structures could be close to the church, but the guideways would be farther away than Alternative 3.3 (Thomas). The columns and guideways would be a significant part of the streetscape as they change from horizontally arranged to vertically arranged along Denny Way. The Denny 3 station would have a moderate impact on Denny Way due to platforms projecting over the sidewalk at about 55 feet and 32 feet. No views of the Downtown skyline would be obstructed, but the view of Elliott Bay could be obscured. Potential impacts of the public views are outlined in Table 4.5-13 below.

Preferred Alternative. The Preferred Alternative through the Seattle Center and Belltown would travel along the south side of W Harrison Street (Alternative 3.1), pass through the Seattle Center on the path of Republican Street and through the EMP (Alternative 3.1.1) to the center of Fifth Avenue N (Alternative 3.1.3). Through Belltown the alignment would be on the west side of Fifth Avenue with the existing monorail guideways removed (Alternative 3.2.1). The stations associated with the Preferred Alternative are Seattle Center/Queen Anne 1A (North), Seattle Center/Fifth and Broad 1A, and Belltown 1A (Center-West). Visual quality, shade, and tree removal impacts for this alternative would be similar to Alternative 3.1, between Elliott Avenue W and Denny Way, and to Alternative 3.2 south of Denny Way along Fifth Avenue.

At First Avenue N the guideways from the south side of W Harrison Street would pass over the Dalmasso Apartments, part of an historic group of buildings, with about eight to twelve feet of clearance, leaving the apartments in place. The guideways would cross over to First Avenue N. to enter the Seattle Center/Queen Anne 1A (North) station. The Seattle Center/Queen Anne 1A (North) station option would be similar in massing and height to the Seattle Center/Queen Anne 1 (North) option, but could have lower visual impacts because the 1A station may be more compatible with the neighborhood's commercial character.

Visual and shade impacts through the Seattle Center would be moderate to high due to the change in Key Arena Plaza, removal and/or replacement of trees, and introduction of the guideway over the Republican Street path and around Memorial Stadium and the Center House. About 20 mature London plane trees

would be removed on the south side of Republican Street and 24 trees could require trimming on the north side. The shade provided by these trees would no longer be available, but trees could be replanted south of the guideway to recreate the shaded edge. The mixed tree border at Memorial Stadium would likely be affected by construction of columns.

The Green Line would pass through the EMP to an alignment with dual horizontal guideways over Fifth Avenue N and then to the Seattle Center/Fifth and Broad 1A, a triple-platform station. Visual and shade impacts would be high due to a crossover at the station and guideway splits to the north and south of the station. This station would be smaller than the Seattle Center/Fifth and Broad 1 (Southeast), but would have platforms spanning Fifth Avenue N, requiring straddle bents. Fifth Avenue N would be shaded during the middle of the day by the platforms.

Visual quality and shade impacts to Fifth Avenue through Belltown between Denny Way and the Belltown station would be as discussed above for Alternative 3.2.1, the west of center alignment removing the existing Seattle Center monorail guideway and columns. The Belltown 1A (Center-West) station alternative would not require removal of any structures (Figure M-46, which can be found in Appendix M of the Draft EIS) and no historic resources would be affected. Alternative 3.2.1 (Remove existing monorail) could result in a positive change because the overhead view from the center of Fifth Avenue would be opened and because the new monorail would use smaller columns than the columns in place along Fifth Avenue now. Because the existing buildings along Fifth Avenue are taller than the planned Green Line guideway, shadow impacts would be limited primarily to morning and midday hours of the day.

Table 4.5-13. Key Public Views – Queen Anne/Seattle Center/Belltown

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view impacts could occur)
Viewpoints		
Kerry Park	M and B	Portions of the guideway for Alternatives 3.1 and 3.2 near the Seattle Center Queen Anne 1 station would be visible from Kerry Park, but views south to the Downtown skyline and Elliott Bay, and west to Puget Sound would not be affected. The Seattle Center/Queen Anne stations 1 and 2 would be visible from Kerry Park, but not appear out of scale with other Seattle Center buildings.
Seattle Center (Mural Amphitheater, Broad Street Green, Fun Forest rides area, and Thomas Street pedestrian area)	F	Portions of the guideway along Alternative 3.3 (Thomas) would be visible from these places, and guideway columns would intermittently interfere with views into these places from Thomas Street.
Scenic Routes		
Denny Way	B	The guideway of Alternative 3.5 (Denny) could interfere with views of Elliott Bay from some parts of Denny Way.
I-5	B	Portions of the guideway of Alternative 3.1 and 3.2 (Mercer) would be visible but would not obstruct views west to the Queen Anne hillside, or south to the Downtown skyline and Space Needle, or to the mountains and Puget Sound beyond.
Broad Street at Seattle Center	M and B	Partial or intermittent interference with views of the Seattle Center and of Puget Sound from Broad Street along the Seattle Center could occur due to the guideway and columns of Alternatives 3.1, 3.2, and 3.3.

Table 4.5-13. Key Public Views – Queen Anne/Seattle Center/Belltown (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view impacts could occur)
Fifth Avenue between Mercer and Stewart Streets	B	Partial or intermittent interference with views of the skyline from Fifth Avenue could occur due to the guideway and columns.
Space Needle Viewpoints		
Myrtle Edwards Park	M	Portions of the guideway along Elliott Avenue would be visible, but the view to the Space Needle would not be affected since the guideway height would be lower than the existing buildings.
Bhy Kracke	M	The view of the Space Needle would not be affected by Green Line facilities.
Shade protected or new parks not yet protected		
None		

F foreground (less than ¼ mile)

M mid-ground (1/4 to 1 mile)

B background (farther than 1 mile)

V view obstruction varies depending on location of the viewer.

Segment 4: Downtown Segment

The Downtown Segment has four possible alignment alternatives and a number of station alternatives. A station service area diagram, created as part of the urban design studies for the Downtown and SODO Segments, is shown in Figure MM-26, which can be found in Appendix MM of this Final EIS. All of the Downtown Segment alignment alternatives would pass by a large number of historic resources, including Smith Tower and King Street Station in the eastern edge of the Pioneer Square Historic District. All alternatives would have similar impacts, with up to 81 resources visually affected. The guideways would be partially visible from Occidental Park and Pioneer Square (Figure M-72, which can be found in Appendix M of the Draft EIS). All alternatives would have a high visual impact, although Alternatives 4.3 and 4.4 would have additional impacts due to stations and structures straddling Second Avenue, as discussed below.

No light and glare impacts are expected in the Downtown Segment under any alternative. Existing light and glare from office and commercial buildings and street lamps are at moderate to high levels throughout this segment; therefore, additional lighting from stations and trains would result in no significant change. The intensity of lighting of the trains is expected to be comparable to existing buildings and vehicles. Some glare from reflective surfaces on trains or stations may occur, but this could be minimized by using low-reflectivity materials or screening, using low-intensity, down-cast lighting (for outside sources).

Computer-modeled shadow studies were generated for all three alignments along Second Avenue for the Seneca-Spring block (Figures MM-37 to 39, which can be found in Appendix MM of this Final EIS) and the University-Union block (Figures MM-40 to 42). The studies modeled the shadows at 10 a.m., 1 p.m., and 4 p.m. for the winter and summer solstices and vernal and autumnal equinoxes. The general results are that where there are tall buildings, shadows from those buildings will dominate during morning and late afternoon/evening hours. This is the typical condition along Second Avenue. Shadows cast by the guideways will be more noticeable where there are no or low buildings and/or at cross streets. During the winter months, the models show that shadows from buildings dominate throughout the day due to the low angle of the sun. The models do not show the diffuse lattice shadows from the emergency walkway between the guideways, but this would also be present.

Shadow impacts will be most noticeable during summer months. Morning and evening shadow bands from the guideways, for all alternatives, will be wider than the midday bands due to the low angle of the sun and will fall on sidewalks or building fronts. Midday shadows will fall near the guideway for all

seasons so Alternative 4.1 (West) would cast narrow bands of shade on the west sidewalk; Alternative 4.2 (East) would cast narrow bands of shade on the east sidewalk; and Alternative 4.3 (Center) would cast narrow bands of shade down the center of the street.

Throughout the year Alternative 4.2 (East) would cast moving shadows over the east sidewalk from noon to sunset. Because there are particularly sensitive public areas on the east side of Second Avenue, this is a greater negative effect than for shadows falling on the west side. Alternatives 4.1 and 4.3 would also cast moving shadows eastward in the afternoon but the shadowing would occur later in the day. The bands would have wider separation, creating a less dense shadow compared to Alternative 4.2. Alternative 4.1 (West) would provide a slight advantage over 4.2 and 4.3 in that the shadows falling on the eastern edge of Second Avenue would occur late in the day, and for most of the day guideway shadows would fall on the street.

Views of the three alignment alternatives toward the west along the east/west streets vary dramatically from viewpoint to viewpoint, and the impacts on views would vary correspondingly. Of the east/west streets in Downtown, University, Seneca, Spring, Marion, and Madison Streets are designated as view corridors west of Third Avenue. Upper level setbacks are required for buildings on those streets per SMC 23.49.024 with the intent of keeping the view window as wide as possible. The setback requirements apply to development outside the right-of-way (inside private property limits). All three alternatives are within the right-of-way through this area. The guideways would obstruct horizontal bands of the views from some vantage points along these east-west streets, depending on the viewpoint.

Simulations were prepared for all of these streets to illustrate the nature of the impacts (Figures M-73 to 78, which can be found in Appendix M of the Draft EIS) and an additional view of the Pike Place Market sign from new Westlake Park (Figure M-79, which can be found in Appendix M of the Draft EIS). Key public views have been considered in addition to the above visual impacts (Table 4.5-14). In addition to these, the added panoramic views of Elliott Bay, Bainbridge Island, the Olympic Mountains, and Mt. Rainier that were not available before would become available due to the elevation and path of the Green Line trains.

Table 4.5-14. Key Public Views – Downtown

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Viewpoints		
Kobe Terrace	F	Portions of the guideway would be visible, but would not obstruct views west to the stadiums, to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Harborview Hospital	M	The guideway would be visible as a small element among other industrial and transportation elements in the SODO area, but would not obstruct views west to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Jose P. Rizal Bridge	F	The guideway would be visible as a small element among other industrial and transportation elements, but would not obstruct views west to the stadiums, to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Scenic Routes		
Alaskan Way Viaduct	F	The guideways would not obstruct views of the Seattle skyline from the Viaduct.

Table 4.5-14. Key Public Views – Downtown Segment (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
I-5	F	Portions of the guideway south of Yesler Way would be visible, but would not obstruct views west to the stadiums, or to Puget Sound or the Olympic Mountains beyond.
Downtown Views		
Bay Street	V	No views to Elliott Bay would be obstructed by the guideway.
Eagle Street	V	No views to Elliott Bay would be obstructed by the guideway.
Broad Street	V	No views to Elliott Bay would be obstructed by the guideway.
Clay Street	V	No views to Elliott Bay would be obstructed by the guideway.
Cedar Street	V	No views to Elliott Bay would be obstructed by the guideway.
Vine Street	V	No views to Elliott Bay would be obstructed by the guideway.
Wall Street	V	No views to Elliott Bay would be obstructed by the guideway.
Battery Street	V	No views to Elliott Bay would be obstructed by the guideway.
Bell Street	V	No views to Elliott Bay would be obstructed by the guideway.
Blanchard, Lenora, Virginia, and Stewart Streets		No views would be obstructed by the guideway.
Pine Street	V	The guideway would partially obstruct views of the Olympic Mountains.
Union Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
University Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Seneca Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Madison Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains.
Marion Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Columbia Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Cherry Street	V	The guideway would partially obstruct views to First Avenue buildings. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
James Street	V	The guideway would partially obstruct views to First Avenue buildings.
Jefferson Street		The guideway would partially obstruct views to Yesler Way buildings.
Yesler Way	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains.
Space Needle Viewpoints		
Olympic Sculpture	B	No portions of the guideway would be visible, and the view to the Space Needle would not be affected since the guideway height would be lower than the existing buildings.

Table 4.5-14. Key Public Views – Downtown Segment (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Shade protected or new parks not yet protected		
Westlake Plaza	F	No impact.
Future City Hall Plaza	F	Would not be affected by Green Line.
Existing City Hall Park adjacent to King County Courthouse	F	Would not be affected by Green Line.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

B background (farther than 1 mile).

V view obstruction varies depending on location of the viewer.

Alternative 4.1 (West Side of Second) would travel along Stewart Street and then along the west side of Second Avenue through Downtown. This is an area with many historic resources that would be affected. For more information, please see Section 4.11, Cultural Resources.

Four station alternatives are being evaluated for this alignment near the intersection of Fifth Avenue and Stewart Street. The Fifth and Stewart 1 (Northwest) and 1A (West) station alternatives would be located at the intersection of those two streets. The Fifth and Stewart 2 (Virginia) station would be located on Fifth Avenue near Virginia Street and spanning Fifth Avenue; visual impacts are expected to be high due to the mass above the street and resulting shadows. The Fifth and Stewart 2A (Virginia-Center) would cross over a portion of the street. The Fifth and Stewart 1 (Northwest) station alternative would occupy most of the block at Fifth and Stewart and require the removal of a large parking structure and several smaller buildings including an historic property (Figure M-54, which can be found in Appendix M of the Draft EIS). A potential elevated walkway between the Stewart station and Westlake Center could be higher than the existing monorail because it would be covered, and this could create a greater visual impact than previously existed. The station would be a substantial presence on the corner because it would occupy most of the site and would be comparable in height to the existing parking garage (about seven stories high) and to the Times Square Building, a historic property. Shadow impacts would be moderate because the Fifth Avenue and Stewart Street corner is fronted on all sides by mid to high-rise buildings. The Fifth and Stewart 1A (West) station option would have similarly high visual impacts as the Fifth and Stewart 2 (Virginia) station because of its overhead pedestrian platforms spanning most of the block between Virginia and Stewart Streets. The 2A station option would have lower impacts because it would not fully span the street. This option also retains the walkway to Westlake Center. The vertically arranged station would not require removing existing buildings because the building would occupy an existing parking lot.

The guideways would curve into the station at Virginia Street on Fifth Avenue and at Fourth Avenue on Stewart Street, thus avoiding traveling directly along the Times Square Building and leaving the Fifth Avenue and Stewart Street intersection unobstructed (except for a potential elevated walkway). The curved guideways could potentially require straddle bents, which, if required, would be a visually prominent component of the Fourth Avenue intersection.

The Fifth and Stewart 2 (Virginia) station would require the removal of the parking structure and two other buildings along Fifth Avenue. This station would have a high visual impact because of the change from vertical to horizontal arrangement of the guideways approaching the station and because of the pedestrian platforms. The lower platform would span Fifth Avenue and could potentially connect the station to the Westin Hotel. The upper platform would be about 40 feet wide and be located between the

guideways, extending over the intersection of Fifth Avenue and Virginia Street about 60 feet above street level. An elevated walkway is also being studied for this station alternative to connect the station's lower platform (about 36 feet above street level) to Westlake Center. The extra-wide upper platform and the change in vertical and horizontal relationships between the guideways would result in additional overhead and support structures. The structure would be a prominent physical and visual element in the blocks between Lenora Street and the intersection of Virginia Street and Fifth Avenue. Shadow impacts due to the station would be moderate; mature trees and mid-rise buildings already shade the intersection of Virginia Street and Fifth Avenue.

The Fifth and Stewart 2A (Virginia Center) station option would have a low visual impact because the platforms would only cover the west sidewalk and parking lane, and the station building size has been minimized to reduce acquisitions and degree of change to the existing streetscape.

Alternative 4.1 (West Side of Second) would then follow the south side of Stewart Street in a vertical arrangement. Alternative 4.1.1 (associated with station alternative Fifth and Stewart 1) would avoid placement directly next to the Times Square building, but Alternative 4.1.2 (station alternative Fifth and Stewart 2) would swing farther south, rounding the corner at Stewart Street and Fifth Avenue. The straddle bents and support structures at the intersection would be prominent physical and visual elements in the intersection and the guideways would pass close to the Times Square building. Depending on the nature of the elevated walkway, it too could be a significant visual feature of the intersection at Stewart Street. The guideway and walkway would partially obstruct views of Times Square's north façade from some vantage points.

Along the south side of Stewart Street, this alignment would affect the mature redwood in the median planter and would use the parking lane for the columns (Figure M-55, which can be found in Appendix M of the Draft EIS). A possible streetscape for Stewart Street is shown in Figure MM-27, which can be found in Appendix MM of this Final EIS, which diagrams the scale and physical relationship of the guideways to the surroundings. The visual impact on the historic buildings along Stewart Street would be adverse (see Section 4.11, Cultural Resources); the decorative band between floors three and four of the Bon-Macy's and the Securities Building could be obstructed from certain vantage points (Figures M-56 and M-57, which can be found in Appendix M of the Draft EIS).

Shadow impacts along Stewart Street would be low because the buildings south of the alignment are taller than the guideways and shade the street and sidewalk.

The alignment would then curve from Stewart Street onto Second Avenue to align with the west side of the street. No structures would need to be removed; however, the street trees south of Union Street would be removed. Fifty to 60 red maples, lindens, honey locusts, and London plane trees could be removed or trimmed between Union Street and S Washington Street. Heights range from newly planted 10 feet to 40 to 50 feet tall. The guideways are expected to have a high visual impact at the Stewart Street/Second Avenue intersection because of the bents that may potentially be used to support the guideways as they curve over the intersection. The straddles, if used, could create visual interference near the Josephinum (an historic property), and the intersection (Figure M-58, which can be found in Appendix M of the Draft EIS). The long-range view down Second Avenue would not be blocked, but would experience different impacts for the different alignment alternatives (Figures M-59, M-60, and M-61, which can be found in Appendix M of the Draft EIS). The Pike Place Market signs would not be obstructed by the guideways or the columns (Figures M-62 and M-63, which can be found in Appendix M of the Draft EIS).

Guideways and columns would be prominent visual features along Second Avenue due in part to the long, straight view down the street and because the height of the guideway would be compatible with the scale of development along Second Avenue (Figure M-59, which can be found in Appendix M of the Draft

EIS). Alternative 4.1 (West Side of Second) would pass in front of the Hoge Building and the Exchange Building, significant historic buildings, obscuring views of the cornice decorations and façade decorations from some vantage points, and resulting in an adverse visual impact to these historic resources (refer to Section 4.11.2.1, Cultural Resources). The view impacts from the third and fourth floor of the Doyle building (located at the southwest corner of Second Avenue and Pine) were studied for center and side alignments and for both vertically and horizontally arranged guideways (Figures MM-32 to 34, which can be found in Appendix MM of this Final EIS). These sketches can apply to views from any building's ground to fourth floors, and impacts will vary significantly depending on the vantage point.

This alignment would pass across the street from Benaroya Hall and next to Seattle Art Museum, two significant public buildings noted for their architectural design and integration of buildings and plaza/open areas. Simulations were created as part of the urban design studies to illustrate visual impacts for the four Downtown Segment alignment alternatives as they pass Benaroya Hall (Figures MM-28 to 31, which can be found in Appendix MM of this Final EIS). These simulations illustrate the scale and spatial relationships of the guideways and columns to the street and Garden of Remembrance at Benaroya Hall. Shadows are shown for a sunny day in the early afternoon. The introduction of the guideways in the area would be a high degree of change.

The overhead structure and columns would change the spatial quality of the sidewalk, but Second Avenue is wide and the overhead structure would still allow the quality of openness to be retained at the pedestrian level. The extension of sidewalks under the guideways and the elimination of parking could maintain the open character. As with Fifth Avenue, building entrances and facades could be harder to discern from a distance due to the presence of columns in front and the guideways overhead (Figure M-67, which can be found in Appendix M of the Draft EIS), which is an adverse impact to the historic resources and to notable civic architecture such as Benaroya Hall. In response to comments received on the Draft EIS, this alternative has been revised. Instead of traveling along Second Avenue in a vertical configuration, the guideways will transition between horizontal between stations and vertical at stations (Figure MM-6, which can be found in Appendix MM of this Final EIS). This revision was made to lessen the visual impact of the guideways from the street, as well as from nearby buildings including Benaroya Hall and the Seattle Art Museum.

Three station locations are associated with Alternative 4.1 along Second Avenue: Pike 1 (West) A and West B, Madison 1 (West), and Yesler 1 (West). All station alternatives are expected to have moderate to high impacts due to the removal of existing buildings and the addition of station buildings and overhead platforms, with platforms and canopies above the sidewalk and street to meet the guideways. All three stations would have high visual impacts on historic buildings.

The Pike and Madison station alternatives would be similar in footprint and height. Pike 1 (West) B would remove the Green Tortoise building and take a parking lot, whereas Pike 1 (West) A would also remove the Eitel Building. These stations would be amid parking lots and garages and the Newmark Building. The Madison 1 (West) alternative would remove the Federal Reserve Bank (Figure M-65, which can be found in Appendix M of the Draft EIS). The Yesler 1 (West) station alternative could have an adverse visual impact on the Smith Tower; however, this would be offset by the removal of the Sinking Ship parking garage. The station would be a prominent feature of the corner, with a structure equivalent to five stories fronting onto Second Avenue, compared to the garage's three levels that slope away from the street. The Yesler Way station would occupy only a portion of the triangular block, leaving the western portion available as an opportunity to create a stronger visual and physical connection to Pioneer Square Park (Figures M-66 and M-67, which can be found in Appendix M of the Draft EIS). The view toward the pergola from the east would no longer be blocked by the garage and the west side of the station plaza could be landscaped to complement Pioneer Square Park and the pergola, effectively

expanding the shaded park area. Sight lines could be established between the west plaza and Occidental Square along Occidental Avenue S and a more attractive view from Occidental Park could result.

Seattle's Land Use Code requires upper level setbacks along designated streets in Downtown. The Madison Street stations would be the only stations falling under this code and they would comply with view corridor setback requirements.

Alternative 4.2 (East Side of Second with Crossover) would affect a number of historic buildings (see Section 4.11, Cultural Resources), but the affected buildings would be the same as those affected by Alternative 4.1, with impacts varying in relative proximity, but all related to the degree of change the introduction of guideways would cause. The guideways curve onto Stewart Street from the west side of Fifth Avenue (Figure MM-7, which can be found in Appendix MM of this Final EIS). After traveling along Stewart Street, Alternative 4.2 would curve through a large parking lot onto Second Avenue to align with the east side of the street. Visual impacts at this corner are expected to be low to moderate because all support structures and the guideways would be outside the pedestrian and traffic zone. The guideway structures here would be comparable in quality and height to the large parking structure to the east. Visual impacts due to Alternative 4.2 would be similar to those of Alternative 4.1, but on the east side of Second Avenue. This alignment would pass next to Benaroya Hall (Figure MM-29, which can be found in Appendix MM of this Final EIS) and the Dexter Horton Building, but would avoid directly fronting the Exchange Building and the Seattle Art Museum. For historic buildings, the visual change would still be considered adverse, and it would remain a relatively high degree of change for other notable buildings.

Four station locations are associated with Alternative 4.2: Fifth and Stewart 3 (Lenora), Pike 2 (East), Madison 2 (East), and Yesler 1 (West). All station alternatives are expected to have moderate to high impacts due to the removal of buildings and the addition of station buildings and overhead platforms, similar to Alternative 4.1. The Fifth and Stewart 3 (Lenora) station is expected to have a moderate visual impact. Four buildings would be removed, but the proposed station would be comparable in scale to the surrounding buildings. The mid-block platforms would create a two-level canopy over the sidewalk but would be high enough (36 and 50 feet) to not significantly affect the spatial quality of the street. Station alternatives Pike 2 and Madison 2 (Figures M-68 and M-69, which can be found in Appendix M of the Draft EIS) would have similar appearances to Pike 1 and Madison 1, and the platform structures would be similar. The impact from the station buildings themselves is expected to be moderate, but the impact due to the overhead platforms would be high. Madison 2 would be located in front of the Wells Fargo Building, removing the stairs and terraces there. The guideways of Alternative 4.2 would alter the spatial quality of the Garden of Remembrance at Benaroya Hall and the paved plaza and sculptures at the Washington Mutual Tower by virtue of the new overhead structure directly adjacent to the buildings. Benaroya Hall, which has a long bank of windows to the south and west, would experience a high degree of change for both external and internal viewers. Shadow impacts would be greater than Alternative 4.1, although still relatively low because the existing trees in the garden and plaza already provide shade throughout the afternoon. The visual impact could be moderate to high because the guideways and columns would contrast with the trees, garden and plaza, and would also be about the same scale as the trees (Figures MM-28 to 31, which can be found in Appendix MM of this Final EIS). Eighty to 85 trees could be removed or trimmed due to the alternative, of species and heights similar to Alternative 4.1.

Alternative 4.2 would cross Second Avenue just south of the Madison 2 (East) station alternative to the west side of Second Avenue to avoid passing directly in front of the Smith Tower. The overhead structure would be highly visible from both a long view down the street and at the crossover due to the special bents or other structures needed to support the curved guideways.

Alternative 4.3 (Center of Second), which would also travel on Stewart Street and Second Avenue, would also affect a number of historic resources. Alternative 4.3 would be the same as Alternative 4.2 through the curve onto Second Avenue from Stewart Street, so impacts would be similar in the area, including adverse impacts to several historic buildings. Visual impacts to the view up or down Second Avenue, however, would be expected to be higher for Alternative 4.3 because guideway columns and beams would be in the center of the street and support structures for stations would straddle the street. Figures M-59 to 61 (which can be found in Appendix M of the Draft EIS) compare the three alternatives from the same viewpoint near Stewart Street and Second Avenue. The view down Second Avenue would be substantially obstructed by the center of street guideway, stations, and street-spanning bent supports. The guideways would be horizontally arranged, so from direct side views the structure would be one rather than two levels. About 20 trees would be affected at station locations, considerably lower than the previous two alternatives.

The Pike 3 (Center), Madison 3 (Center), and Yesler 2 (Center) station alternatives could also have a greater visual impact than side-of-street stations because they would extend across the street to the center of Second Avenue, where the guideways would be located (Figures M- 70 and 71, which can be found in Appendix M of the Draft EIS). This alternative would place a large pedestrian platform for the Yesler Way station in front of the Smith Tower entrance. The lower platforms would be approximately 30 feet above street level, similar in height to the top of the guideways of the existing monorail on Fifth Avenue. On top of the platforms would be additional stairs and/or escalators to reach a second platform at the level of the trains (45 to 50 feet above street level). The straddles that span Second Avenue and the platforms they support would create two covered sections along Second Avenue, substantially affecting the current open character of the street.

Alternative 4.4 (East of Center of Second with Crossover). Visual quality and shadow impacts for Alternative 4.4 along Second Avenue in Downtown would be similar to those of Alternative 4.3 (Center of Second). As with Alternative 4.3, trees would be removed only at station locations. The stations associated with this alternative are Fifth and Stewart 3(Lenora, Pike 2A (East-Center), Madison 2A (East of Center) (Figure MM-8, which can be found in Appendix MM of this Final EIS), and Yesler 1 (West). Visual impacts due to station Madison 2A (East-Center) would be between Madison 3 (Center) and Madison 2(East) because the platforms would extend over a portion of Second Avenue, but less than for the center alignment.

Preferred Alternative. The Preferred Alternative for the Downtown Segment is Alternative 4.1 (West of Second) with Alternative 4.1.2 as the transition from Fifth Avenue to Stewart Street. The Preferred Alternative would have lessened visual impacts compared to the other alignments, although the overall visual impacts would remain significant. The alternative would pass by a large number of historic resources, including Smith Tower and King Street Station in the eastern edge of the Pioneer Square Historic District. This alignment would pass across the street from Benaroya Hall, and next to Seattle Art Museum, two significant public buildings noted for their architectural design and integration of buildings and plaza/open areas. The guideways would be partially visible from Occidental Park and Pioneer Square. The impacts would be lessened with the vertical guideways at stations flattened to horizontal between the stations. This would reduce the impact on views westward along Union, University, Seneca, Marion, Columbia, and Cherry Streets. In addition, an east-to-west crossover is not needed, as required by Alternatives 4.2 and 4.3. Because the Preferred Alternative is aligned with the west side of the street, visual impacts to the view south along Second Avenue would be reduced and the open character of the street would be better preserved.

Station alternatives for the Preferred Alternative are Fifth and Stewart 2A (Virginia), Pike 1 (West) A, Madison 1 (West), and Yesler 1 (West). These stations would have lower visual and shade impacts on sidewalks and the street than the other alternatives because the platforms only extend over the sidewalk

and a traffic lane, leaving the center line and east side unobstructed. The vertically arranged Fifth and Stewart 2A (Virginia Center) station option would not require removing existing buildings because the building would occupy an existing parking lot. Pike 1 (West) A and Madison 1 (West) stations would be similar in footprint and height. Pike 1 (West) A would remove the Green Tortoise building, a parking lot, and the Eitel Building, and would be amid existing parking lots, garages, and the Newmark Building. The Madison 1 (West) station would remove the Federal Reserve Bank (Figure M-65, which can be found in Appendix M of the Draft EIS).

The Yesler 1 (West) station alternative would be a prominent feature of the Yesler-Second Avenue corner. It would be a structure equivalent to five stories fronting onto Second Avenue, compared to the garage's three levels that slope away from the street. The station would occupy only a portion of the triangular block, leaving the western portion available as an opportunity to create a stronger visual and physical connection to Pioneer Square Park (Figures M-66 and M-67, which can be found in Appendix M of the Draft EIS). The Yesler 1 (West) station could have an adverse visual impact on the Smith Tower.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

In this segment, impacts to visual resources would be associated with visual contrast and view obstruction near the south edge of Pioneer Square Historic District and the area around King Street Station, removal of buildings, addition of station structures and the potential for an Operations Center south alternative, and the presence of the elevated guideway structure. However, impacts to historic resources within the Pioneer Square Historic District are considered as part of the alternatives evaluation in the previous section (Downtown Segment).

Shade, light, and glare would cause varying levels of impact within the segment. In the pedestrian-oriented areas of south Pioneer Square and King Street Station, shading on walkways and gathering places would generate a perceptible level of change to the visual environment, whereas existing visual impacts in the areas adjacent to the two stadiums and in the industrial portion of the SODO Segment would make additional impacts less noticeable. Because of the high level of existing lighting throughout this segment, additional lighting from stations and the train itself would have low to moderate impacts. Some glare from reflective surfaces, primarily at stations and on the monorail trains themselves, may be visible to motorists and pedestrians passing in this segment. This potential impact could be further minimized by incorporating preventive measures in the project design, such as choice of materials or screening.

Alternative 5.1 (East Side of Third/Utah). At the north end of the SODO segment, asphalt parking lots, replacement of historic structures with modern commercial structures, and a general level of disrepair in this area reduce viewer sensitivity to low to moderate (Figure M-80, which can be found in Appendix M of the Draft EIS). Views south to the historic King Street Station would be partially obstructed (Figures M-81 and M-82, which can be found in Appendix M of the Draft EIS). The alignment would cross South Jackson Street diagonally, turning to pass along the west face of King Street Station. The east/west view between Pioneer Square and the International District would be partially obstructed by the guideway structure, as would middle distance views of both King Street and Union Stations (Figures M-83 to M-85, which can be found in Appendix M of the Draft EIS). In addition, views east to King Street Station from the Seahawks Stadium parking lot would be partially obstructed by the guideway and the Weller/King Street 1 (Event) station (Figure M-86, which can be found in Appendix M of the Draft EIS). Otherwise, the Weller/King Street 1 (Event) station would both fit appropriately into its transportation-intensive surroundings, and would not be expected to generate impacts.

Visual impacts from the Safeco Field 1 station alternative, immediately east of Safeco Field, would be low due to the large to extremely large scale of this area, low expectations of viewers for viewpoints, and lack of view obstruction (Figure M-87, which can be found in Appendix M of the Draft EIS). The

stadiums are both very large-scale facilities, surrounded by transportation and industrial uses, and the Green Line would not greatly affect their surrounding setting.

Station alternatives Lander 1 (Northeast), Lander 2 (Southwest), and Lander 3 (Diagonal) would require removal of buildings. Alternatives Lander 2 (Southwest) (Figures M-88, from Appendix M of the Draft EIS, and MM-10, from Appendix MM of this Final EIS) and Lander 4 (Utah) would be associated with the Operations Center (Figure M-90, which can be found in Appendix M of the Draft EIS). Lander 4 would be part of the center and therefore could have the lowest visual impacts of the three alternatives. If the south alternative SODO Operations Center is constructed, it would cause the removal of all existing structures along the south side of Utah Avenue S, between S Lander and S Hanford Streets. Although this would cause substantial change to the visual environment, the industrial nature of the area, large scale of buildings, existing railroad lines and yards, and low viewer expectations of views in this area would result in a low- to moderate-level impact. Twenty to thirty street trees would be removed or trimmed, mostly maples between 15 and 40 feet tall.

Alternative 5.2 (West Side of Third/Utah). Visual impacts of Alternative 5.2 would be similar to Alternative 5.1 along their common alignment near Seahawks Stadium and Safeco Field. Lander 3 (Diagonal) would require removal of buildings but would have no structures over S Lander Street because the station is set back from the right-of-way (Figure M-91, which can be found in Appendix M of the Draft EIS).

In response to comments received on the Draft EIS and ongoing engineering work, the alignment in this area has been altered to provide a shorter crossing of Amtrak and BNSF tracks north of Safeco Field. Impact levels from this alternative would be low because of the scale and nature of the surroundings.

Weller/King Street 2 (Event) would be a horizontally arranged station sized to accommodate event crowds (Figure MM-9, which can be found in Appendix MM of this Final EIS). Conceptual studies of the King Street Station area were done as part of the urban design process to evaluate the scale and spatial relationships of the King Street station to its environs (Figure MM-35 and 36, which can be found in Appendix MM of this Final EIS). King Street Station, a historic property, would be adversely affected by the visual change of the guideway (see Section 4.11). Because this station would be located near Safeco Field and existing Amtrak and BNSF tracks, overall visual impacts from this alternative would be low.

The alignment has been revised south of S Royal Brougham Way to make the diagonal crossing of Amtrak and BNSF tracks north of the original crossing, reducing impacts on the Seattle Public Schools property on S Lander Street. Areas adjacent to this alignment currently are affected by BNSF tracks, trains, overhead utilities, and warehouse buildings. Additional impacts from the guideway structures in this area would be low.

Lander 3 (Diagonal) station would be located on private property north of S Lander Street between First and Occidental Avenues S. The station has been revised to be aligned diagonally to the street grid in a northeast to southwest direction. Several commercial structures would be removed as part of this alternative. However, because of industrial settings, existing streets, overhead utilities, and medium- to large-scale buildings in the vicinity, impacts from this alternative would be expected to be low. The Lander 3 station could have lower visual impacts than Lander 1 and Lander 2 because it does not front onto Lander Street. Ten to 15 trees could be removed. This alternative includes storage tracks and switches on both ends on Third Avenue S at S Holgate Street. These structures are directly adjacent to the railroad corridor and are expected to have a low visual impact due to the transportation structures in the area.

At the south end of the segment, the guideway would pass over the Alaskan Way Viaduct to meet the West Seattle Bridge. The view from under S Hinds Street in SODO is illustrated in Figure M-92, which can be found in Appendix M of the Draft EIS. Potential impacts of the public views are outlined in Table 4.5-15 below.

Alternative 5.2(s) (West Side of Third/Utah single beam). The single beam configuration would result in lower visual quality and shade impacts than the dual beam configuration of Alternative 5.2 because the support structure would not have the overhead armature of the dual beam configuration. Switches at the Safeco Field and Lander stations would provide the transition between single and dual guideway configurations, but are expected to be less massive than switches between two horizontal guideways. The single beam arrangement would have a more open quality along the street and shading effects would be lower than a dual beam arrangement. Tree impacts would be the same as those for Alternative 5.2.

Preferred Alternative. The Preferred Alternative for the SODO Segment is Alternative 5.2(s), an alignment that would feature a single beam configuration on the west side of Third Avenue S south of Safeco Field and a diagonal approach to Utah Avenue S with a dual beam passing area at the Lander station and another dual beam passing area near S Horton Street. The single beam configuration would have lower visual quality and shade impacts than a dual beam configuration because the support structure would not have the overhead armature of the dual beam configuration. Stations included in the Preferred Alternative would include: Weller/King 2, Safeco 1, and Lander 3 (Diagonal).

Weller/King Street 2 (Event) would be a horizontally arranged station sized to accommodate event crowds. This station is larger than Weller/King Street 1 (Event) station, but because it would be located near Safeco Field and existing Amtrak and BNSF tracks, additional impacts from this alternative would be low.

Table 4.5-15. Key Public Views – SODO

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Second Avenue and Yesler Way	F V	Guideway structure could partially obscure southward views of King Street Station.
S Jackson Street between Second and Sixth Avenues	F-M V	Guideway structure could partially obscure views between Pioneer Square and the International District.
Seahawks Stadium Parking Lot	F	Guideway structure could partially obscure views of King Street Station and contrast with the station's historic architecture.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

B background (farther than 1 mile).

V view obstruction varies depending on location of the viewer.

Visual impacts from the Safeco Field 1 station alternative, immediately east of Safeco Field, would be low due to the large to extremely large scale of this area, low expectations of viewers for viewpoints, and lack of view obstruction (Figure M-87, which can be found in Appendix M of the Draft EIS). Similarly, because existing transportation and industrial uses currently generate high-level impacts in this area additional impacts from the Green Line would not greatly affect their surrounding setting.

Lander 3 (Diagonal) station would be located on private property north of S Lander Street between First and Occidental Avenues S. The station has been revised to be aligned diagonally to the street grid in a northeast to southwest direction. Since it does not front onto S Lander Street visual impacts to the street would be low. This station alternative could have lower impacts than either the Lander 1 or Lander 2 alternatives. Three commercial structures would be removed as part of this alternative. However, because of existing impacts from streets, overhead utilities, and medium to large scale buildings in the vicinity, additional impacts from this alternative would be expected to be low.

Segment 6: West Seattle Segment

In this segment, visual impacts could result from the introduction of station and guideway structures, removal of existing buildings, and the potential addition of a new bridge spanning the Duwamish Waterway or the addition of a guideway structure atop the existing West Seattle Bridge. Impacts could include view limitations, introduction of light, glare and shadow, and visual contrast between proposed development and commercial areas, residential neighborhoods, and a park.

For all alternatives in this segment, shade would cause varying levels of impact. In pedestrian-oriented areas (e.g., California Avenue SW and the commercial area at the intersection of SW Alaska Street and 44th Avenue SW), shading on walkways and gathering places would generate a perceptible level of change to the visual environment. However, in areas along upper SW Avalon Way, and SW Alaska Street existing impacts from heavy traffic and automobile oriented businesses would reduce the expectation for an impact-free environment. Shade from a new monorail-only bridge over the Duwamish Waterway (Alternative 6.2) could cause a substantial increase in shading in areas below the bridge.

High levels of existing lighting in parts of this segment (e.g., West Seattle Bridge, Fauntleroy Way SW) would likely result in low-level impacts from additional light and glare from the Green Line. However, viewers in residential areas (e.g., California Avenue SW, SW Avalon Way) would be more likely to perceive changes in the visual environment generated by light from stations and trains, including the trains' headlights, which would be similar to a typical automobile's. Additionally, glare from reflective surfaces of stations and trains may be visible to motorists and pedestrians passing through this segment.

Alternative 6.1 (West Seattle I) as it enters the south end of this segment would have a flyover crossing of an elevated section of SR 99 that could partially obscure north/south views along the viaduct, a designated SEPA scenic route. Because this would be experienced in the brief time that motorists approach and pass beneath the flyover, the level of this impact would be low to moderate. Pedestrians and cyclists passing between SODO and West Seattle would also have their views partially obscured by the support columns of the flyover structure; however, because of existing impacts from elevated roadway and industrial uses in this view area, impact levels would be low.

Crossing the West Seattle Bridge, the guideway would be located between the east and west lanes of the bridge, approximately on the bridge's centerline. The guideway would be elevated, allowing for north/south views to the Downtown skyline and the surrounding waterfront for Green Line passengers. However, the guideway columns could briefly obstruct these same views for motorists passing over the bridge. Although the guideway on the West Seattle Bridge would be visible from Belvedere Viewpoint Park on SW Admiral Way, the distance of the viewpoint from the bridge and the very large scale of the bridge would not result in significant changes to this visual environment (Figure M-93, which can be found in Appendix M of the Draft EIS). Similar to the new Ship Canal Bridge, the FAA could require a low-intensity, steady red light for purposes of air navigation atop the Green Line structure on the West Seattle Bridge.

Under Alternative 6.1, there are two options for the transition between the West Seattle Bridge and the Delridge neighborhood. Under Alternative 6.1.1 (Past Pigeon Point), the guideway would remain on the West Seattle Bridge until it intersects Delridge Way SW. Under Alternative 6.1.2 (To Pigeon Point), the guideway would pass through the north edge of the W Duwamish Greenbelt at Pigeon Point between W Marginal Way SW and the eastbound onramp for the bridge. This would result in removal of vegetation from the greenbelt and could result in visual impacts to views of the greenbelt. Ecosystem impacts from vegetation removal are discussed in Section 4.15, Plants and Animals. Up to 40 trees could be removed along Delridge Way SW.

The EIS studies a single beam configuration for the West Seattle Bridge crossing (Alternative 6.1(s)). This single beam configuration would be expected to result in lower visual impacts than Alternative 6.1 because the support columns could be somewhat smaller than those required for a dual beam configuration and because the guideway would not need the overhead armature of the dual beams.

The height and scale of the guideway would contrast with the small scale of some of the structures along Delridge Way SW; however, existing impacts from arterial traffic on Delridge Way SW reduce viewer expectations, resulting in a moderate level of impact from the route. Crossing the Longfellow Creek Greenbelt basin would require a guideway height of approximately 75 feet. Most land uses in this area, including office buildings, parking facilities, and the Nucor Steel Plant, would not be affected by resulting height and scale impacts. The Delridge 1 (26th) station and guideway alternatives would have moderate to high visual impacts on Longfellow Creek Greenspace because the station and guideway would be aligned over Longfellow Creek near the intake culvert at SW Andover Street (Figures M-94, which can be found in Appendix M of the Draft EIS, and MM-11, which can be found in Appendix MM of this Final EIS). Tall deciduous trees would screen the visual impact from within the Greenspace. The potential increase in parking near the station and the change in vegetation in the buffer could contribute to the impacts. Additional discussion is also provided for effects in this area in Section 4.15, Plants and Animals, and Section 4.10, Parks and Recreation.

Ascending from SW Andover Street the alignment would travel along SW Avalon Way, a SEPA scenic route. The guideway's location in the right-of-way's center would partially obscure scenic views southward from the street to the Downtown skyline (Figure M-95, which can be found in Appendix M of the Draft EIS). Southwest views of the Cascade Mountains could also be affected, although these impacts would likely be occasional and minimal. Twenty to 25 lindens, maples, and other varieties of trees would be removed along SW Avalon Way and Fauntleroy Way SW. Arterial traffic, the relatively large scale of the predominantly multifamily residences in this area, and automobile-oriented land uses would likely not result in impacts related to contrast of height, scale, and character. Although the Avalon 1 (Center) station would be located in the road's center, it is not located in a section of SW Avalon Way with scenic views or sensitive viewers (Figure M-96, which can be found in Appendix M of the Draft EIS). Passengers on the Green Line would have enhanced views in this area, owing to the elevated position of the monorail and resulting lack of obstruction by vehicles, commercial signage, and low commercial structures in this area.

Along both Fauntleroy Way SW and SW Alaska Street, Alternative 6.1.3 (Northwest Side of Fauntleroy) would travel along the west edge of the roadway and Alternative 6.1.4 (Southeast Side of Fauntleroy) would be located on the east edge. Visual impacts along the alignment in this area are not expected to be significant, because this area features primarily automobile-oriented businesses and high volumes of arterial traffic. About 10 linden could be removed along SW Alaska Street.

As the alignment turns southward, it would enter an area in which development is comprised of primarily small-scale single-family residences and small- to moderate-scale multifamily residences and commercial buildings. Along 42nd Avenue SW, both the guideway and the vertical Alaska Junction 1 (42nd/Edmunds) station would be located on the west edge of the street (Figure M-97, which can be found in Appendix M of the Draft EIS). The proposed Green Line developments match the scale and height of surrounding land uses; however, they may partially obscure views to the Olympic Mountains from the mixed residential/commercial area on the east side of the street. Crossing to California Avenue SW, the alignment would require removal of several small-scale residential and commercial structures, resulting in a moderate change in the visual character in this area.

Alaska Junction 1A would be a side platform station in the same location as Alaska Junction 1. This station alternative would affect its surroundings similarly to Alaska Junction 1 with contrasts due to height, potential view blockage, and removal of existing buildings.

On California Avenue SW, views southward and downhill along the roadway would be partially obscured by the guideway (Figure M-98, which can be found in Appendix M of the Draft EIS), because the alignment would travel along the center of the road right-of-way until reaching the southern terminus station at Morgan Junction, located on the west side of California Avenue SW. Although there are no existing public east/west scenic views along this part of the route, the guideway structure could obscure foreground distant and cross-street views for residents and businesses along California Avenue SW (including a Seattle landmark at 4740 California Avenue SW). This alignment would remove or trim about twenty pines and lindens on California Avenue NW and ten to fifteen maples and fruit trees along Fauntleroy Way SW.

Morgan Junction 1A (West) would be a single platform station in the same location as the Morgan Junction station in Alternative 6.1, and would affect its surroundings similarly, although impacts would be lower than Morgan Junction 1 due to its smaller size with the single platform.

The EIS studies another opportunity for a single beam configuration along California Avenue SW. Alternative 6.1.6 (s) (West side of California single beam) would be aligned on the west side of California Avenue SW (Figure MM-12, which can be found in Appendix MM of this Final EIS). Between Morgan Junction and just south of SW Hudson Street, this alternative would utilize a single beam. Impacts from this alternative would be similar to those along California Avenue SW in Alternative 6.2 (East side of California). North/south views along California Avenue SW would be less obscured than those in Alternative 6.1; however, viewers on the west side of California Avenue SW would likely experience a higher level of impacts from view obstruction and the scale of the guideway. Additionally, following the west edge of the road right-of-way could entail permanent removal of about twenty existing street trees. The single beam guideway would generate impact levels somewhat lower than those in dual beam alternatives on California SW, except in areas with switches (Morgan Junction and south of SW Hudson Street), where impacts would be similar to dual beam alternatives.

The Morgan Junction 1 station alternative would require the removal of several small businesses. This station would have double crossover switches just north of SW Graham Street, which would increase the bulk and width of the alignment and station here. Because land uses adjacent to the station include the recent addition of moderate to large-scale commercial buildings, the station would be expected to have a moderate impact on the area (Figure M-99, which can be found in Appendix M of the Draft EIS).

Alternative 6.2 (West Seattle II) would include construction of a high-level bridge, north of the West Seattle Bridge (a SEPA scenic route), to cross the Duwamish Waterway. The bridge would be about the same height as the existing West Seattle Bridge, but it would be a prominent feature in the visual landscape and could generate several types of visual impacts. As an element of mid-ground and background views (Table 4.5-16), the proposed bridge would match the scale, height, bulk, and form of the existing bridge, and would not be expected to cause significant impacts. This structure would be a key part of foreground views, especially those from beneath the bridge and on the adjacent waterfront. Despite high-level existing impacts from the existing bridge and adjacent industrial land uses, the proposed bridge would noticeably alter the visual character of the existing visual resources. Additionally, the view north to the Seattle skyline from the existing bridge may be partially obstructed by the proposed Green Line Bridge, and the character of this scenic route would be altered.

Table 4.5-16. Key Public Views – West Seattle

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Alaskan Way Viaduct (6.2)	F-M-B V	Flyover could partially obscure skyline views.
West Seattle Bridge	F-M-B V	Columns for guideway could partially obscure views.
Belvedere Viewpoint Park	B	Proposed changes could cause low-level impacts from change in visual character.
SW Avalon Way	B V	Guideway would partially obscure skyline views.
35 th Avenue SW	M-B V	Guideway columns could partially obstruct views; guideway would contrast with existing character.
35 th Avenue SW and SW Oregon Street	M-B V	Guideway columns could partially obstruct view; guideway could contrast with existing character.
West Seattle Stadium Park	F-M	Proposed changes would cause impacts from change in visual character.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

B background (farther than 1 mile).

V view obstruction varies depending on location of the viewer.

This alignment would avoid the West Duwamish Greenbelt and Delridge neighborhood by turning broadly through sparsely developed property west of Delridge Way SW. The alignment would follow the southeast edge of SW Andover Street, to station alternative Delridge 2 (Andover) (Figure M-100, which can be found in Appendix M of the Draft EIS). Approximately twenty-five bigleaf maple, alder and Douglas fir could be removed along SW Andover and SW Yancy Streets.

Impacts along SW Avalon Way would be similar to those generated by Alternative 6.1, except that instead of continuing toward Fauntleroy Way SW, the alignment would turn south to follow the east edge of 35th Avenue SW (a SEPA scenic route) and the west edge of the West Seattle Stadium Park. The Stadium Park is a City of Seattle Park and SEPA viewpoint (see Section 4.10, Parks and Recreation). Scenic public views along this part of the alignment are toward the east, and include the Cascade Mountains and distant hillsides. These views would not be obscured by the guideway; however, guideway columns could cause occasional partial obstruction. This could be partially mitigated by spacing the columns as far apart as possible.

Alternative 6.2.1 would travel along the east side of 35th Avenue SW adjacent to the park use the Avalon 2A (35th) station alternative. This station would be located on park property, on the sloped, wooded area that is currently a 40- to 50-foot-tall screen of mature conifers on the west side of a sports field (see Section 4.2, Displacements and Relocation). Approximately 50 to 60 trees would be removed. The intersection of 35th Avenue SW and SW Oregon Street is a designated SEPA viewpoint (Figure M-101, n Appendix M of the Draft EIS). The viewpoint is currently obstructed by the evergreen screen. Because the proposed station would be elevated, replacing the conifer screen with the proposed station would partially recreate this viewpoint. Impacts due to this station alternative would be high because the wooded buffer would be removed (Figure M-101) and park property would be lost (please refer to Section 4.10.3, Mitigation, for a discussion of replacement property). This would affect views from and to the stadium site since the wooded hillside provides a backdrop to the field events inside the stadium. The guideways and station would contrast with the character of the existing amenities.

Alternative 6.2.2 would be aligned along the center of 35th Avenue SW, between SW Avalon Way and SW Alaska Street. The center alignment would reduce obstruction of westward views from southbound lanes of 35th Avenue SW, and increase them for northbound drivers. The center alignment would obstruct north-south views along the roadway, however these are not designated scenic views. By avoiding the

east edge of West Seattle Stadium Park, this alternative would avoid disturbance and removal of the tree screen, and reduce the level of contrast between the guideway and the park.

Avalon 2B station alternative would serve the center-aligned guideway of Alternative 6.2.2. Located in the center of 35th Avenue SW, it would not affect West Seattle Stadium Park through removal of trees or by encroaching on park land. Visual contrast between park amenities and the station would be much less than with Avalon 2A because of increased distance and visual screening between the park and station (Figure MM-13, which can be found in Appendix MM of this Final EIS).

The alignment would then turn west, following the center of SW Alaska Street through an area of mixed small to medium scale retail and multi-family residences. Although existing visual resources do not include scenic public views, foreground and cross-street views would be partially obscured by the guideway structure. Visual impact levels would be moderate through most of this part of the alternative, with the exception of the area surrounding the intersection of SW Alaska Street and 44th Avenue SW. Here, the guideway would contrast with the well-maintained early to mid twentieth century buildings, the pedestrian-oriented streetscape, and the closely spaced businesses, resulting in a marked contrast with the existing visual resources. About ten mature trees would be removed for this alignment.

Alternative 6.2.1 would align with the north side of SW Alaska Street. East/west views along SW Alaska Street would be less obscured than with a center alignment; however, viewers on the north side of SW Alaska Street would likely experience a higher level of impacts from view obstruction and the scale of the guideway.

The alignment would turn south to follow the east side of 44th Avenue SW for one block, and would include Alaska Junction 2 (44th/California) station alternative (Figure M-102, which can be found in Appendix M of the Draft EIS). Current development in this area includes a parking lot and several small to mid scale apartments and commercial buildings. Although the Green Line would likely contrast somewhat with the visual character of this area, the resulting impacts would not be significant.

The alignment would take a broad turn eastward, joining California Avenue SW and following the east side of the street to the southern terminus. Impacts along this part of the alternative would be similar to those along California Avenue SW in Alternative 6.1. North/south views along California Avenue SW would be less obscured than those in Alternative 6.1; however, viewers on the east side of California Avenue SW would likely experience a higher level of impacts from view obstruction and the scale of the guideway. Additionally, following the east edge of the road right-of-way could entail permanent removal of existing street trees. Approximately 110 lindens and 10 maples would be removed or trimmed.

Alternative 6.2 would extend southward past Fauntleroy Way SW, terminating with Morgan Junction 2 (Center) station alternative, which would be located near the center of the road right-of-way (Figure M-103, which can be found in Appendix M of the Draft EIS). The Morgan Junction 2 station alternative would have a double crossover switch just north of the station and tail tracks with a single crossover south of the station, for storage of out-of-service trains. The switches would create a greater visual impact combined with the station because of the extra columns and guideways. However, the station is in recently developed neighborhood/commercial district so the impact would be moderate.

Alternative 6.3(s) (Delridge North Subsegment). Starting from Pigeon Point, this subsegment alignment alternative for the Delridge area would use a single beam configuration and would transition to a route adjacent to the south side of the West Seattle Bridge. The guideways would turn south to follow the center of SW Avalon Way. Because of existing high impact levels from the West Seattle Bridge and the Nucor Steel plant, impacts from Pigeon Point to SW Avalon Way would be low level. Along SW

Avalon Way, the guideways would pass the west side of Nucor, several businesses, and two- to five-story multi-family residences. Impact levels in this area would be expected to be moderate to low.

Delridge 3 would be a side platform station located on the south side of SW Spokane Street west of the intersection with Delridge Way SW. Because of existing impacts from the West Seattle Bridge, surface streets, and large-scale Nucor buildings, this station is expected to have low-level impacts to its surroundings.

Alternative 6.4 (Andover/Yancy Subsegment). This subsegment alternative for the Delridge area would cross SW Andover Street east of SW 26th Street, running about 45 feet south of SW Andover. The alignment would then turn southwest to align with the north side of SW Yancy Street, and would then take the same route as Alternative 6.1 along SW Yancy Street to SW Avalon Way. This alternative would include the Delridge 1A (26th) station, which would have moderate to high visual impacts on Longfellow Creek Greenbelt because the station and guideway would be aligned over the buffer at the intake culvert at SW Andover Street (Figure MM-14, which can be found in Appendix MM of this Final EIS). About ten mature trees would be removed for this alignment.

A single beam option on the Alternative 6.4 (**Alternative 6.4(s)**) alignment is also being considered. This alternative would not have a Delridge station. Without a Delridge Station, the impacts along SW Andover Street would be somewhat reduced from the other alternatives in the Delridge area. Where single beam alignments would be utilized in this alternative, they would reduce view blockage and diminish the bulk of the guideway for viewers looking parallel to the guideway.

Alternative 6.5 (Genesee Subsegment). This subsegment alternative for the Delridge area would turn out of the Delridge Way SW right-of-way at Delridge 4 Station near the intersection with SW Genesee Street. The alignment would then continue on the west side of Delridge Way SW, before making a broad turn west onto SW Genesee. Along Delridge Way SW, land uses include several medium scale office buildings and a number of single-family residences. Because existing impact levels from the roadway, traffic and utilities are relatively high, the addition of the guideway, along with removal of several houses, would generate moderate level impacts.

Delridge 4 Station would be located on State Department of Social and Health Services (DSHS) property on the west side of Delridge Way SW, north of the intersection with SW Dakota Street. Its height, scale, and bulk would be similar to adjacent office buildings. Light and glare from the station may be somewhat greater than that currently experienced in the adjacent area. Overall impacts from this station would be low to moderate.

On SW Genesee Street, the alignment would cross to the south side of the street, following the north edge of the grounds of the Delridge Community Center, and the West Seattle Golf Course and Recreational Center (Figure MM-15, which can be found in Appendix MM of this Final EIS). It would cross Longfellow Creek Greenbelt and ascend to meet the dual beam alignment of Alternative 6.2. Alternative 6.5 would affect visual resources along SW Genesee Street in several ways. The scale and height of the aerial would contrast with small-scale single-family houses on the north side of the street, and also with the scale of the two-lane roadway. The guideway would contrast visually with residences and with public open space on the both sides of the street. The guideway would need to be elevated approximately 90 feet to cross Longfellow Greenbelt and climb to SW Avalon Way. This would result in obstruction of east-west views along the guideway.

The guideway would also displace mature street trees along the south side of SW Genesee Street (on the grounds of the Delridge Community Center), and other mature trees in the West Seattle Golf Course and Recreational Center. The resulting level of the combined impacts of the guideway on SW Genesee Street would be high, but impacts to the golf course would be low since the guideways are high enough to not block views to the north, and no shadows would fall on the golf course. Golfers now look at homes and

midrise apartment buildings to the north of the course, and this view would be altered by the presence of the guideways.

Preferred Alternative. The Preferred Alternative for the West Seattle Segment is a combination of subsegment alternatives. : Alternative 6.1.1(s), a single beam configuration across the West Seattle Bridge past Pigeon Point to the Delridge Way SW/SW Andover Street intersection. This alignment would avoid the Pigeon Point greenbelt and therefore have significantly lower impacts than Alternative 6.1.2. The single beam option would reduce view blockage and diminish the bulk of the guideway compared to the dual beam option.

Alternative 6.3(s) with a single beam configuration is the preferred subsegment through the Delridge area, in part because it would avoid the Longfellow Creek Greenspace by passing north of the Nucor steel plant. This subsegment would use the Delridge 3 (Nucor) station alternative. Impacts from this alternative would be much lower in this area than the alternatives that would pass over or adjacent to the greenspace.

Alternative 6.2.2 with a dual beam configuration is the Preferred Alternative from the SW Avalon Way/35th Avenue SW intersection to the north side of SW Alaska Street along the center of 35th Avenue SW. The Avalon 2B station is the Preferred Station Alternative. Impacts from this center alignment and west-side station would be much less than Alternative 6.2.1 because the center alignment and station would avoid the mature tree screen in West Seattle Stadium Park. Views from inside the park would not be affected by this alignment since the trees would remain. Visual contrast between park amenities and the station would be much less than with Avalon 2A because of increased distance and visual screening between the park and station (Figure MM-13, in Appendix MM of this Final EIS).

Alternative 6.1 is the Preferred Alternative through the Alaska Junction area with the Alaska Junction 1 station. Alternative 6.1.6(s) is the Preferred Alternative for the California/Morgan Junction area with the Morgan Junction 1A station alternative. Alternative 6.1.6 (s) is a single beam alignment on the west side of California Avenue SW. The single beam option would reduce view blockage and diminish the bulk of the guideway compared to the dual beam alternatives, but would require the removal of many street trees along the west side.

4.5.2.2 No Action Alternative

Under the No Action Alternative, there would be no visual impacts related to the alignment of the proposed Green Line. Visual changes to the segments would result from increased vehicular traffic on these roads and associated development. Conversely, no new scenic views as seen from the Green Line would be created.

4.5.3 Mitigation

This section discusses potential mitigation measures that could be implemented for all alternatives. The urban design study process described below is considered to be foundation for all mitigation concepts that will be developed during the design development phase.

4.5.3.1 Operation

SMP is committed to a community design process that would determine design solutions that are appropriate and that carefully consider the preferences and requirements of community members, property owners, and stakeholders. To this end, the SMP initiated an urban design process to identify a set of guidelines that would support and inform the integration of the Monorail with the communities and city of Seattle. The Green Line's urban design team, after considerable research, community input, and various design studies, completed the "System-wide Urban Design and Landscape Study" and a suite of station and streetscape concepts (Appendix MM, which can be found in Volume Two of this Final EIS).

The System-wide Study provides urban design goals, principles, and criteria that are intended to ensure that the new monorail in the urban landscape will be a quality-of-life enhancement. The Study resulted in draft design guidelines (Appendix MM) that set standards for the Green Line to provide safe and easy access to the monorail and other transit options; be a landmark in the urban landscape; benefit each neighborhood along the monorail; and be responsive to community plans.

The Study was conducted with these assumptions in mind:

- The Green Line should reinforce and integrate the unique characteristics of Seattle and its communities with a response to form and function that is appropriate to the context
- The monorail will be experienced within the city at a full range of scales, from regional to intimate, over time. Therefore, the guidelines are structured to reflect the dynamic scale of the city context to assure design integration at all scales
- The monorail and its place in the city should be evaluated using the criteria of placemaking, environment, aesthetics and function
- The monorail is a significant piece of civic architecture

Public/private partnerships and a meaningful, sincere community involvement process are required for successful implementation of City and community long-range goals in conjunction with operation of the Green Line. The results of the community involvement process undertaken by the SMP will be incorporated into the architectural and design work for the Green Line, with the intention of mitigating impacts and enhancing community assets. The study will be used as part of the City of Seattle's review and permitting of the Monorail transit facilities. The guidelines will also be included in the DBOM package to ensure that the monorail's design and construction are responsive to community needs and plans.

Other additional actions include:

- The Monorail Review Panel, consisting of members of the City of Seattle Design and Planning Commissions and the Design Review Boards, will review and make recommendations on station and facility designs. The Panel will review plans both before they are submitted to the City of Seattle for permitting and during the development of Detailed Design Requirements.
- Facilities would be integrated with area redevelopment plans as appropriate, particularly at stations. (In the event that future projects are proposed for station areas, those projects would undergo separate environmental review as needed.)
- Source shielding would be used in exterior lighting at stations and ancillary facilities, such as maintenance bases and park-and-ride lots, to ensure that light sources (such as bulbs) are not directly visible from residential areas, streets, and highways, and to limit spillover light and glare in residential areas.
- Where practicable, existing street trees along the sidewalks will be retained, or new vegetation planted, to help soften the visual appearance of the monorail facility.
- Green Line columns and guideways would be limited in bulk to the extent possible based on sound engineering design so that shadow and scale impacts are minimized. SMP has developed Design Guidelines that are described in more detail in Chapter 5. The Design Guidelines process – in collaboration with the City – will be used to prepare and approve designs for columns, guideway, and stations. In addition, the specifications for the DBOM contractor provide for a collaborative, “over-the-shoulder” review process, including a public design hearing, to confirm the design concepts for the guideway and major structures. This review process, along with a

detailed permitting process, will determine the final designs for the guideways, columns, and stations.

4.5.4 Significant Unavoidable Adverse Impacts

The Green Line would be set in an urban context where visual change is expected, and differences in scales of structures are typical. However, the perception of some viewers may be that the visual changes associated with the Green Line in Downtown, at the Ship Canal crossing, and at the Seattle Center are significant, particularly when considered at a single location. The far west bridge alignment alternative across the Ship Canal would result in changes to the visual character of the Fishermen's Terminal area that would be perceived as significantly adverse to some viewers.

Historic resources are found throughout the corridor and the introduction of the Green Line, a modern structure, would change their setting and some views of the resources. In several areas of the city, including Pioneer Square, the Historic Resources analysis finds that there would be a significant adverse visual impact on historic resources. For a full discussion of impacts to historic resources, please refer to Section 4.11, Cultural Resources.

The City of Seattle's Downtown and Seattle Center are dynamic settings with existing structures similar to the Green Line and the overall degree of change within the context of these larger neighborhoods is typically moderate. Some viewers would perceive the visual change to Seattle Center as adverse, but other viewers would perceive the changes to be highly consistent with the character of Seattle Center, and not adverse. In the Downtown area, adverse visual effects would occur for historic resources, some views of Puget Sound would be partially obstructed. The appearance and character of Second Avenue and some of its important civic architecture, including Benaroya Hall and the Seattle Art Museum, would be significantly altered. Still, the Green Line structure would be consistent with the Downtown urban development trend that includes high density, high rise buildings and intensive transportation activity.

4.6 AIR QUALITY

4.6.1 Affected Environment

4.6.1.1 Air Quality Regulations and Standards

This section summarizes relevant air quality regulations and data on the existing air quality in the Seattle metropolitan area.

The federal government has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. In addition, the Washington Department of Ecology (Ecology) has established State Ambient Air Quality Standards (SAAQS), as shown in Table 4.6-1, which are at least as stringent as the NAAQS. The U.S. Environmental Protection Agency (EPA) has delegated air quality program implementation for most issues to Ecology and to the Puget Sound Clean Air Agency (Clean Air Agency).

Table 4.6-1. State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	Federal	Washington
Carbon Monoxide	8 hours	9 ppm	9 ppm
	1 hour	35 ppm	35 ppm
Lead	Calendar Quarter	1.5 µg/m ³	1.5 µg/m ³
Ozone	1 hour	0.12 ppm	0.12 ppm
	8 hours*	0.08 ppm	--
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	0.05 ppm
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm
	24 hours	0.14 ppm	0.10 ppm
	3 hours	0.5 ppm	0.5 ppm
PM ₁₀	Annual Geometric Mean	50 µg/m ³	50 µg/m ³
	24-hour Average	150 µg/m ³	150 µg/m ³
PM _{2.5}	Average Annual Arithmetic Mean*	15 µg/m ³	--
	24-hour Average*	65 µg/m ³	

Notes: ppm = parts per million; µg/m³ = micrograms per cubic meter; PM₁₀ = particulates with an aerodynamic diameter of less than or equal to 10 micrometers; PM_{2.5} = particulate with an aerodynamic diameter of less than or equal to 2.5 micrometers.

* EPA promulgated new standards for ozone and PM_{2.5} in September 1997. The EPA is now in the process of implementing the new standards.

Sources: EPA Office of Air Quality Planning and Standards (OAQPS); Washington Department of Ecology, 1998 Air Quality Data Summary, April 2000.

Geographic areas in which concentrations of a pollutant exceed the ambient air quality standards are classified as nonattainment (i.e., do not attain standards) areas. Federal regulations require states to prepare State Implementation Plans (SIPs) that identify (1) emission reduction strategies for nonattainment areas and (2) maintenance strategies for areas that were in nonattainment, have improved air quality, and have been redesignated as attainment areas. Prior to 1978, the central Puget Sound region was designated as a nonattainment area for both ozone and carbon monoxide (CO). In 1996, the EPA redesignated the region as an attainment area and approved the associated air quality maintenance plans. The maintenance plans for ozone and CO include transportation-related measures. CO control measures include vehicle inspection and maintenance programs and congestion management if needed in locations with high measured CO values. Ozone control measures include a public smog awareness program to encourage voluntary changes in behavior to reduce emissions during weather conditions that could trigger

elevated ozone levels. This program is targeted at getting people to reduce use of personal vehicles, gasoline-powered lawn mowers, and products that emit volatile organic compounds (Clean Air Agency web site).

In 1987, the Seattle Duwamish industrial area was designated as a nonattainment area for particulate matter with an aerodynamic diameter of 10 micrometers or less (PM₁₀). In May 2001, this area was redesignated as an attainment area for PM₁₀ and is now subject to the associated maintenance plan. The PM₁₀ maintenance plan focuses primarily on industrial sources. The maintenance plan for the area, issued by the Clean Air Agency and approved by EPA, states that emissions come primarily from industrial sources (83 percent), with a minor amount of emissions from diesel exhaust (eight percent) and gasoline-fueled motor vehicles (four percent). The maintenance plan does not include emissions reductions that have resulted from EPA-required reductions in fuel sulfur content for diesel fuel in 1993 and gasoline in 2000, although both of these measures would be expected to reduce PM₁₀ formation resulting from vehicle emissions (Federal Register, Volume 66, Number 49, pages 14492 to 14497). EPA is currently implementing a new federal standard for particulate matter less than or equal to 2.5 micrometers in diameter (PM_{2.5}). Monitoring data for several locations in the central Puget Sound region indicate that PM_{2.5} levels will likely comply with EPA's new PM_{2.5} 24-hour standard. However, these same data are less conclusive regarding compliance with the new annual average standard. The data indicates that motor vehicles are not the primary contributor to PM₁₀ issues in the Duwamish maintenance area (Ecology, 2000-2002 Air Quality Trends Report).

WAC 173-420 and 40 CFR 93 seek a demonstration of conformance with the purpose and intent of the SIP for transportation projects. In order to maintain conformity with the air quality implementation plans, transportation projects should not (1) cause or contribute to any new violation of the NAAQS, (2) increase the frequency of any existing violation of the NAAQS, or (3) delay the timely attainment of the NAAQS. Projects are also required to come from a conforming transportation plan. The Puget Sound region is in attainment with all NAAQS; therefore, the only relevant provisions of WAC 173-420 for the project are not to cause or contribute to a new NAAQS violation and to come from a conforming transportation plan. The demonstration of not contributing to a new NAAQS violation is considered to be met if it is shown that the CO NAAQS will not be exceeded at intersections affected by the project.

Clean Air Agency Regulation I, Articles 5 and 6 require certain types of stationary sources and stationary sources with emissions above certain thresholds to obtain a permit to operate, or to register emissions (refer to Section 4.6.2.1 for additional information on how the determination is made). These regulations may apply to the Green Line Operations Center or to stations. These regulations are designed to prevent significant air quality impacts from stationary sources.

4.6.1.2 Existing Conditions

The Seattle area is currently a designated attainment area for all pollutants. Over the past decade, air quality in the Seattle area has improved even while traffic congestion and vehicle miles traveled (VMT) have increased (Ecology and Clean Air Agency web sites). The main pollutants of concern for transportation projects in the Seattle area such as the Green Line are CO and ozone. Particulate matter is also a concern. The most recently published, fully validated air quality data for the Puget Sound region covers 1999 through 2001. The Clean Air Agency currently prepares an air quality summary every three years. Although the data have not been fully validated, data collected since 2001 support the same conclusions presented for the 1999 to 2001 period.

- **Carbon Monoxide.** CO forms when the carbon in fuels does not burn completely. Higher levels of CO generally occur in areas with high traffic congestion levels during stagnant winter weather conditions. Vehicle emissions are the primary source of CO in the Puget Sound region. Ecology

maintains CO monitoring stations in areas with high traffic congestion levels, including central business areas, roadsides, and shopping malls.

The Puget Sound airshed was in compliance with the 8-hour CO standard for the years 1999 to 2001. Maximum concentrations for CO ranged from 2.8 to 7.5 ppm, well below the 8-hour standard of 9 ppm. Because measured 1-hour concentrations are historically much lower than the 35 ppm standard, 1-hour CO trends were not tracked. Maximum and second highest measured 1-hour CO were 16.1 and 15.6 ppm in 1999, 10.5 and 8.6 ppm in 2000, and 9.5 and 8.8 ppm in 2001 (Clean Air Agency, 1999-2001 Air Quality Data Summary).

Based on discussions with the Clean Air Agency, dispersion modeling was performed at three intersections that could potentially be affected by the Green Line alternative alignments. The results of the modeling analysis document that existing CO concentrations are below both the NAAQS 8-hour and the 1-hour CO air quality impact criteria for these intersections.

- **Ozone.** Ozone issues tend to be regional in nature because the chemical reactions that produce ozone occur over a period of time. Volatile organic compounds (VOCs) and nitrogen oxides (NO_x) react with sunlight to produce ozone. High ozone levels occur during summer. Vehicle emissions are the primary source of VOCs and NO_x in the Puget Sound region (Clean Air Agency web site). Seattle currently has a maintenance program in place to maintain compliance with the NAAQS.

According to the data for 1999 to 2001, the Puget Sound air basin maintained attainment for ozone. This means the three-year average of the fourth-highest 8-hour concentration never exceeded the NAAQS. Because of how the ozone standard is defined, the three highest concentrations can exceed the level of the standard while still maintaining attainment. In 1999, the highest 8-hour concentration at Enumclaw (0.090 parts per million [ppm]) exceeded the level of the standard; in 2000, the highest and second-highest concentrations exceeded this level. The majority of monitoring stations measuring ozone are located in rural areas of Puget Sound. In the Puget Sound region, the hot sunny days favorable for ozone formation are typified by light north-to-northwest winds. By the time the highest concentration of ozone has formed in the afternoon and early evening, it has been transported 10 to 30 miles from the original source. Consequently, the highest concentrations of ozone in the Puget Sound region are measured in areas such as North Bend, Enumclaw, and Eatonville. Regional trends show a flat ozone level or a slight decrease over the 1999 to 2001 period (Clean Air Agency web site).

- **PM₁₀.** PM₁₀ includes both solid and aerosol particles suspended in the air. The Puget Sound airshed was in compliance with both the annual and 24-hour standards for PM₁₀ for the years 1999 through 2001. No monitored values exceeded the annual standard of 50 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or the 24-hour standard of 150 $\mu\text{g}/\text{m}^3$. Annual PM₁₀ trends have flattened since 1998 and are well below the 50 $\mu\text{g}/\text{m}^3$ standard. In the Duwamish PM₁₀ maintenance area in south Seattle, the maximum 24-hour PM₁₀ concentration has remained relatively flat since 1998 at a level of 80 $\mu\text{g}/\text{m}^3$, well below the 150 $\mu\text{g}/\text{m}^3$ standard (Clean Air Agency web site).
- **PM_{2.5}.** The Puget Sound airshed was in compliance with both standards for PM_{2.5} for the years 1999 through 2001. The annual standard of 15 $\mu\text{g}/\text{m}^3$ was not exceeded at any of Ecology's monitoring stations. Although the highest PM_{2.5} concentration measured in 2000 (70 $\mu\text{g}/\text{m}^3$) exceeded the standard, it did not violate the standard. Because of the way the daily PM_{2.5} standard is defined, the three-year average of the 98th percentile of daily concentrations must not exceed 65 $\mu\text{g}/\text{m}^3$. In 2000, the 98th percentile was 49 $\mu\text{g}/\text{m}^3$ (second highest concentration) and was the highest 98th percentile of PM_{2.5} measured in the Puget Sound region in 1999 through 2001. For the 1999 to 2001 period, concentration trends for PM_{2.5} were flat at the 98th percentile of daily levels of 30 to 50 $\mu\text{g}/\text{m}^3$ and annual daily levels of 10 to 12 $\mu\text{g}/\text{m}^3$. The long-term trend indicates a gradual downward tendency in PM_{2.5} concentrations (Clean Air Agency web site).

- **Air Toxics.** The Clean Air Agency has prepared a Draft Puget Sound Air Toxics Evaluation that identifies diesel particulate matter (diesel soot) as the primary contributor to cancer risk in the Puget Sound region. Wood smoke, and other mobile source related toxics were also identified as contributors to potential cancer risk (see Section 4.17, Construction, for discussion of air toxics emissions from construction vehicles).

4.6.2 Impacts

4.6.2.1 Operational Impacts

This section summarizes the air quality impacts that could result from operation of the Green Line. Emissions sources potentially associated with the Green Line are the monorail itself, stationary sources such as the Operations Center and stations, and increased emissions or concentrations as a result of changes to traffic patterns. This section also summarizes the Green Line's compliance with the Washington SIP.

The Green Line itself will be powered by electricity and would not have combustion-related emissions. Any of the Green Line alternative alignments under consideration would likely reduce regional vehicle miles traveled (VMT). This could reduce regional vehicles emissions on a long-term basis and could provide an overall, long-term air quality benefit as a result. In addition, all of the Green Line alternative alignments would offer an alternative transportation mode to the public during air quality alert conditions. There is no significant difference in the VMT reduction among alternatives.

An estimate of the typical weekday regional pollutant emissions was made and is shown in Table 4.6-2. When compared to the No Action Alternative, the Green Line is projected to reduce regional Volatile Organic Compound (VOC) emissions by approximately 120 pounds per day, and regional NO_x emissions by approximately 130 pounds per day. Any reduction in VOC and NO_x emissions assists the Puget Sound region's strategy to remain in attainment for ground level ozone (smog). Air pollutant emissions reductions between any of the Green Line alternatives and the No Action alternative also occur for CO (550 pounds per day).

Table 4.6-2. Estimated Typical Weekday^a Regional Pollutant Emissions (pounds/day)

Alternative	Daily VMT ^b	VOC	CO	NO _x
Existing Conditions	3,409,100	14,530	124,680	17,860
No Action	3,978,300	11,060	50,710	12,090
Green Line	3,935,800	10,940	50,160	11,960

Notes: VMT = Vehicle miles traveled; VOC = Volatile organic compounds; CO = carbon monoxide; NO_x = nitrogen oxides

^a Year 2020, except Existing Conditions are year 2003 data. Estimates based on a 30 mile per hour regional speed assumption – this will likely somewhat underestimate emissions reductions resulting from implementation of the Green Line.

^b Refer to Section 4.1, Transportation.

The Project has also been regionally modeled by the Puget Sound Regional Council (PSRC), a positive air quality finding has been made, and conformity with State and Federal air quality standards has been determined. The Project has been included in the 2004-2006 Regional Transportation Improvement Plan (TIP), which has been approved by FHWA and FTA. The Green Line itself is not a source of particulates and would not cause or contribute to any new violations of the PM₁₀ NAAQS.

The Green Line Operations Center and some stations may have sources of pollutants such as combustion sources for heating. If these stationary sources have certain types of equipment or emit more than certain

thresholds of pollutants, they will be subject to requirements to register, or to obtain an authority to operate from the Clean Air Agency. Clean Air Agency regulations for stationary sources are designed to prevent significant air quality impacts.

To assess the potential impacts of changes to traffic patterns, the operating conditions of the Green Line were modeled to determine whether any of the alternatives could cause long-term localized air impacts. The analysis determined that the Green Line is not expected to cause local hot spots. All of the Green Line alternative alignments would have the potential to result in long-term localized air quality impacts if, as a result of the project, local congestion at intersections increases to a point where the CO NAAQS is exceeded. Because of improvements in emission reduction technology for vehicles and the vehicle maintenance and inspections programs used to reduce vehicle emissions in the Puget Sound area, local hot spots (intersections with CO levels that exceed the CO NAAQS) have not been observed to occur in the last few years (see discussion of CO levels in the Existing Conditions section) and are not expected as a result of the Green Line. This finding was verified with a dispersion analysis that was performed at three intersections. The analysis of local impacts at intersections included the traffic expected to be generated at Green Line stations.

To select the three intersections for analysis, intersections potentially affected by the project were ranked by total entering volume and level of service (LOS) (see Section 4.1, Transportation, Tables 4.1-20 and 4.1-21 – Ballard Segment; Tables 4.1-27 and 4.1-28 – Interbay Segment; Table 4.1-34 – Queen Anne/Seattle Center/Belltown Segment; Table 4.1-40 – Downtown Segment; Table 4.1-45 – SODO Segment; and Table 4.1-50 – West Seattle Segment).

Intersections that are stop-sign controlled generally do not have sufficient traffic volumes to cause air quality impacts. At intersections with higher traffic volumes and congestion levels (poor LOS), it is more likely that pollutant concentrations adjacent to the intersection could exceed the CO NAAQS. Therefore, the signalized intersections affected by the project and projected to operate at LOS D, E, or F were selected as a subset with potential air quality impacts. The three intersections analyzed were selected from the subset with potential air quality impacts as follows: (1) **15th Avenue NW/NW Market Street (Alternative 1.2 [Market 2])**, the intersection with the highest entering volume and the third worst LOS; (2) **Fourth Avenue S/S Royal Brougham Way (all alternatives)**, the intersection with the worst LOS and delay; and (3) **California Avenue SW/SW Morgan Street/Fauntleroy Way SW (Alternative 6.1 [Morgan Junction 1])**, the intersection with the worst LOS and delay in the West Seattle Segment to address geographic distribution of potential project impacts. These intersections are expected to result in the highest projected CO concentrations as a result of the Green Line because they have the combined worst performance and highest traffic volumes. For each intersection, the Green Line alternative with the highest traffic volume and worst delay was selected and only that alternative was analyzed in detail. Since the alternative with the worst projected operating conditions was not projected to cause an air quality impact, none of the other alternatives including the Preferred Alternative would be expected to cause an air quality impact.

The highest CO concentration modeled at each intersection is identified in Tables 4.6-3 and 4.6-4. Both 1-hour and 8-hour CO concentrations were estimated. The three intersections selected are expected to result in the worst increases in pollutant concentrations as a result of any Green Line alignment alternatives including the Preferred Alternative, and no exceedances of the CO NAAQS are projected at these intersections. Therefore, no exceedances of the CO NAAQS are expected at any intersection as a result of the project. None of the Green Line alternative alignments are expected to cause long-term adverse air quality impacts and the Green Line would not cause or contribute to a violation of the NAAQS. Air quality impacts are not a significant consideration in selecting among Green Line alternative alignments.

Table 4.6-3. Highest Projected 1-Hour Carbon Monoxide Concentrations Near Intersections (ppm)

	Existing	2010		2020	
		No Action	Action	No Action	Action
15 th Avenue NW/NW Market Street ^a	9	7	7	5	6
Fourth Avenue S/S Royal Brougham Way ^b	10	8	8	7	7
California Avenue SW/SW Morgan Street/ Fauntleroy Way SW ^c	7	5	5	5	5

^a Ballard Segment intersection.

^b SODO Segment intersection.

^c West Seattle Segment intersection.

Table 4.6-4. Highest Projected 8-Hour Carbon Monoxide Concentrations Near Intersections (ppm)

	Existing	2010		2020	
		No Action	Action	No Action	Action
15 th Avenue NW/NW Market Street ^a	7	5	5	4	4
Fourth Avenue S/S Royal Brougham Way ^b	7	6	6	5	5
California Avenue SW/SW Morgan Street/ Fauntleroy Way SW ^c	5	4	4	3	3

^a Ballard Segment intersection.

^b SODO Segment intersection.

^c West Seattle Segment intersection.

4.6.2.2 Impacts of the No Action Alternative

Tables 4.6-3 and 4.6-4 list the results of the intersection hot spots analysis. The CO hot spots modeling results for the No Action Alternative show that no intersections included in the analysis would cause an exceedance of the NAAQS or SAAQS in 2010 or in 2020. With the No Action Alternative, there would be no project-related sources of emissions and no reductions in projected VMT.

4.6.3 Mitigation

All of the Green Line alternative alignments including the Preferred Alternative could be expected to decrease regional VMT and associated regional emissions and would likely have a positive impact on regional air quality. None of the alternatives would be expected to cause or contribute to any local exceedance of the NAAQS. No adverse air quality impacts are expected as a result of the project, and no mitigation is needed.

The intersections and alternatives selected for the hot spots analysis represent the worst projected operating conditions and therefore the worst air quality impacts. For the 15th Avenue NW/NW Market Street intersection Alternative 1.2 was analyzed. Operation of the Ballard Preferred Alternative 1.1(s) for this intersection is projected to have lower delay than Alternative 1.2. This would result in lower air quality impacts for the Preferred Alternative. The analysis of Fourth Avenue S/S Royal Brougham Way is representative of all alternatives, including the Preferred Alternative. For the California Avenue SW/SW Morgan Street/Fauntleroy Way SW intersection, Alternative 6.1 was analyzed. Operation of the West Seattle Preferred Alternative 6.1.6(s) for this intersection is projected to have lower delay than Alternative 6.1. This would result in lower air quality impacts for the Preferred Alternative.

4.6.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse air quality impacts are expected as a result of any of the Green Line alternatives or the No Action Alternative.

4.7 NOISE AND VIBRATION

This section summarizes the noise and vibration impact analysis in support of the environmental review of the proposed Green Line. Technical details of this analysis are presented in Appendix R, Noise and Vibration Backup Information in the Draft EIS.

4.7.1 Affected Environment

4.7.1.1 Introduction to Noise Terminology and Descriptors

The human ear responds to a wide range of sound intensities. The decibel (dB) scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. Using this scale, humans perceive an increase of 10 dB as a doubling of loudness; for example, a 70 dB noise level sounds twice as loud as a 60 dB noise level. Under ideal listening conditions, people generally cannot detect differences of 1 dB, while differences of 2 or 3 dB can usually be detected by people with normal hearing. In the outside environment, and especially near complex noise sources such as roads, sound level changes of 2 or 3 dB might not be noticeable to most people, while a 5 dB change would likely be perceived as a clear and noticeable change.

Because of the logarithmic scale used to describe noise, a doubling of a noise source strength (e.g., twice as much traffic on a road) produces a 3 dB increase in average roadway noise. Such an increase would not be perceived as a doubling in noise loudness, which requires a 10 dB increase. Sound levels caused by line sources (e.g., relatively long, variable, or moving sound sources) such as traffic decrease at a rate of 3 to 4.5 dB when the distance from the road is doubled, depending on the type of surface between the source and the receiving property (e.g., hard or soft). Sounds from discrete events or stationary point sources, such as an idling bus, decrease by 6 dB when the distance from the source is doubled. Conversely, halving the distance to a source increases sound levels by 3 dB and 6 dB for roadway and point sources, respectively.

When addressing the effects of noise on people, one must consider the frequency response of the human ear, or those sounds that people hear best. To address the frequency response, instruments that measure sounds are designed to weight measured sound levels based on emphasizing the frequencies people hear best, and de-emphasizing those frequencies people do not hear as well. The frequency weighting most often used to evaluate environmental noise is A-weighting, and measurements from instruments using this system are reported in A-weighted decibels or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

For a given noise source, factors affecting the sound transmission from the source and the potential related noise impact include distance from the source, frequency of the sound, absorbency of the ground surface, the presence or absence of obstructions and their absorbency or reflectivity, and the duration of the sound. The degree of impact on humans may also depend on existing sound levels. For example, if existing sound levels are high, introducing a new noise source tends to have less impact than in an environment where background noise levels are low. Typical sound levels of some familiar noise sources and activities are presented in Table 4.7-1.

Many regulatory agencies use the equivalent sound level (L_{eq}) to evaluate noise impacts. The equivalent sound level is the level of a constant sound that has the same sound energy as the actual fluctuating sound. As such, the L_{eq} can be considered an energy-average sound level. But this noise metric should not be confused with a simple arithmetic average that may under-represent high and low values; an L_{eq} tends to emphasize louder sound levels because they contain more sound energy than lower levels. And the L_{eq}

has been found to be highly correlated to community perceptions of noise and to the potential for annoyance from noisy activities. When referring to sound levels, it is important to identify the time period being considered, with $L_{eq}(24)$, for example, being the equivalent sound level for a 24-hour period. The day-night sound level (L_{dn}) is similar to an $L_{eq}(24)$, except that the calculation involves adding 10 dBA to sound levels measured between 10:00 p.m. and 7:00 a.m. to account for potential sleep interference.

Table 4.7-1. Sound Levels Produced by Common Noise Sources

Thresholds/ Noise Sources	Sound Level (dBA)	Subjective Evaluations ^a	Possible Effects on Humans ^a
Human Threshold of Pain Carrier jet takeoff at 50 feet	140	Deafening	Continuous exposure to levels above 70 dBA can cause hearing loss in the majority of the population
Siren at 100 feet Loud rock band	130		
Jet takeoff at 200 feet Auto horn at 3 feet	120		
Chain saw Noisy snowmobile	110		
Lawn mower at 3 feet Noisy motorcycle at 50 feet	100	Very Loud	
Heavy truck <i>maximum</i> at 50 feet City bus <i>maximum</i> at 50 feet	90		
Aerial Rail Transit @ 50 mph at 50 feet Busy urban street, daytime	80	Loud	Speech interference
Idling Bus @ 50 feet Monorail @ 40 mph at 50 feet	70		
Air conditioning unit at 20 feet Conversation at 3 feet	60	Moderate	Sleep interference
Quiet residential area Light auto traffic at 100 feet	50		
Library Quiet home	40	Faint	
Soft whisper at 15 feet	30		
Slight rustling of leaves	20	Very Faint	
Broadcasting Studio	10		
Threshold of Human Hearing	0		

^a Note that both the subjective evaluations and the physiological responses are continuums without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.

Source: EPA (1974) and others.

4.7.1.2 Operational Impacts: Methods of Noise Analysis

Green Line Train Noise Modeling

The Green Line operational noise impact assessment was conducted using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM v. 2.1 - USDOT 2003). This tool is the latest available computer model developed by FHWA for assessing noise from line sources such as roads.

Using this tool, noise from the Green Line was estimated based on monorail trains running on elevated guideways along the alternative alignments. This approach was developed based on source-specific sound level measurements of a Bombardier Mark VI monorail in use at Walt Disney World in Orlando, Florida. This modeling used varying numbers of light-duty vehicles to simulate the operation of the Green Line at projected varying travel speeds along the alignment alternatives (excluding SODO, where there are no sensitive receivers).

The Traffic Noise Model (TNM) calculates hourly L_{eqs} due to line sources and can consider effects of terrain, the presence of obstacles that can impede sound transmission, and the effects of varying ground types between the source and the receptors. In this instance, the model was used to estimate noise from the Green Line by considering one train traveling in each direction at the average speed in a number of subsections of each alternative Green Line segment. Model results were then scaled up to represent the number of trains expected in each hour of the day. This number was then converted to an L_{dn} (a 24-hour sound level) that could be compared with both existing sound levels (Table 4.7-5) and with Federal Transit Administration (FTA) impact thresholds (Table 4.7-3). Refer to Appendix R, Noise and Vibration Backup Information in the Draft EIS, for additional information regarding this modeling and the source sound measurements.

After completion of the Draft EIS, the Green Line alternatives were refined and modified in response to comments and a Preferred Alternative was recommended. The entire alignment of the Preferred Alternative except the SODO Segment was subsequently evaluated with TNM modeling. The important details of this aspect of the analysis are described below.

In addition to considering the Preferred Alternative, some aspects of modeling for the Draft EIS were modified to reflect alternative modifications and refinements in the several portions of the Green Line segments that were made after completion of the Draft EIS in response to comments. These changes included both slight modifications to some segments of the previously considered alignments, as well as one new alignment alternative in the Delridge area of West Seattle. Results of all such changes are described in the following sections.

Model Receptors

The noise impact modeling examined the five segments of the Green Line alignment alternatives that include residential uses, and so did not consider the SODO Segment. Each segment of the Green Line was further subdivided into smaller sections to consider changes in expected travel speeds along each section. The noise modeling used series of theoretical receptors to represent sensitive receiving locations in each segment. Model receptors were placed to represent three general locations relative to the Green Line guideway as follows: (1) residential locations at the backside of the sidewalk, (2) residential uses set further back from the sidewalk, and (3) second row setback residential properties (i.e., homes at least one-half block from the nearest major road or guideway). Receptor locations were established based primarily on the presence of residential uses and were located as needed on both sides of the guideway. In some cases, additional non-residential-use receptors were employed to examine the potential noise implications in parks and in commercial areas of the various alignments. Receptor locations were held constant with all alternatives to enable comparison of the potential noise implications of the alternative alignments.

The TNM assessment of the Preferred Alternative used the same modeling receptors considered in the previous evaluation, and added new receptors in several areas where it was necessary to refine the analysis. In addition, the modeling of the Preferred Alternative was modified in two important ways compared with the previous modeling. First, the modeling of the Preferred Alternative considered the modified peak and non-peak monorail headways expected to occur with the single-beam configuration. Secondly, the latest modeling used a refined speed profile representing the expected operation of the

Preferred Alternative configuration. To accommodate the greater resolution of the speed profile, the five corridor segments evaluated with modeling were considered in smaller subsections than were used in the previous modeling. This change is reflected in some tables reporting the results of the impact analysis, and the differences in the Draft EIS and Final EIS analysis assumptions are explained below.

The noise impact modeling performed for the Draft EIS assumed the entire Green Line alignment would be a dual beam configuration, and used the vehicle headway and speed profiles associated with that configuration. The headways were assumed to be 4 minutes during the peak travel periods and 8 minutes during non-peak hours. This resulted in a total of 375 train trips per day across the system. In contrast, the noise modeling for the Preferred Alternative conducted for the Final EIS used single beam configurations in several areas along with revised assumptions regarding train headways along different sections of the Green Line. Downtown, headways were assumed to be 2.75 minutes during peak-period travel, four minutes during a midday rush, and eight minutes in off-peak hours. Outside the Downtown area, headways were assumed to be 5.5 minutes during the morning and evening peaks, and eight minutes in all off-peak hours. These assumptions resulted in a total of 487 trips daily across the Downtown system, and 326 trips per day across the system outside the Downtown.

The Draft EIS modeling used a speed profile developed for the ".1" alignments (those designed with a ".1" in their description in the Draft EIS), and applied these assumed speeds to all alternatives. To simplify the analysis, the speed profile was applied to relatively large sections of the Green Line alternatives, and the modeling did not consider slowing in the vicinity of stations. In contrast, the Final EIS modeling for the Preferred Alternative used a new and more refined speed profile developed for this alternative, and the modeling applied this information with greater resolution, including some slowing (but not stopping) at stations and switches. The combination of the revised headway and speed assumptions means the noise modeling for the Preferred Alternative is the most accurate to date, but it also means that it is not precisely comparable to the results of the earlier modeling. While all the analyses represent a conservative analysis based on conservative assumptions, the non-Preferred Alternative analysis was slightly more conservative and presents slightly greater impacts as a result. The more refined modeling conducted for the Final EIS is more accurate than the previous analysis, which was necessarily somewhat less detailed because of the number of alternatives that were considered. The most recent analysis is the most complete and realistic to date.

4.7.1.3 Regulatory Overview

The noise impact analysis employed the noise impact criteria developed by the FTA because these criteria are widely used to analyze noise from transit projects. These criteria are explained in the text below and illustrated in Tables 4.7-2 and 4.7-3.

Federal Transit Administration Noise Criteria

The FTA describes its noise impact criteria for transit projects in the manual entitled *Transit Noise and Vibration Impact Assessment* (FTA 1995). These criteria apply to rail projects, including monorails; fixed facilities such as transit stations, maintenance facilities, and park and ride lots; and buses traveling on local roads or in bus-only highway lanes.

FTA transit noise impact criteria are based on the land use category of the receiving properties (Table 4.7-2). The criteria for lands with sensitive nighttime uses (i.e., sleeping) are based on the day-night sound level (L_{dn}). Criteria for lands with uses confined primarily to daytime activities are based on the hourly Leq of the noisiest hour of transit-related activity, especially during periods of increased sensitivity to noise. FTA noise criteria apply based on the uses of the affected properties, and apply more stringent definitions of impact for residential uses and locations where quiet is the basis for use. Less stringent

limits pertain to commercial and other institutional uses that typically do not involve nighttime uses for sleeping.

Table 4.7-2. Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(1) ^a	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels, where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(1) ^a	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as do places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

^a Equivalent sound level of the noisiest hour of transit-related activity during period of noise sensitivity.

Source: FTA (1995).

FTA noise impact criteria consider both the overall sound levels and the sound level increases that would occur due to a transit project. A simple way to summarize these impact criteria is by comparing noise that would be caused by a project with existing sound levels. Figure 4.7-1 provides a graphic representation of the FTA impact criteria; the specific *impact* and *severe* threshold levels used by FTA are listed in Table 4.7-3. Under these criteria, receiving locations with low existing sound levels can be exposed to relatively more project noise before an impact occurs. Conversely, the relative allowed levels of project-related noise are lower in locations with higher existing sound levels. For example, a residential location with an existing 40 dBA Ldn would not be considered severely impacted unless project noise would be 15 dBA or more higher than existing, but a location with a 60 dBA Ldn baseline would be considered severely impacted by a project-related noise level only 3 dBA higher than existing (63 dBA).

The FTA noise policy provided the main criteria used in assessing the potential for impacts from the Green Line. The assessment for receptors representing residential receivers was based on measured and calculated Ldns (24-hour Leqs with an added nighttime noise weighting) because such locations are used for sleeping. The assessment for parks and commercial receptors was based on the highest measured and calculated hourly Leq.

While the FTA impact criteria shown in Figure 4.7-1 and Table 4.7-3 use the terms *impact* and *severe* to describe the impact thresholds, the relative significance of impacts under these criteria is not specifically defined by FTA. As shown in Figure 4.7-1, the FTA noise impact criteria are delineated by two curves that allow increasing project noise levels as existing noise increases, up to a point. Beyond that point, impact is determined based on the project noise alone. Below the lower curve in Figure 4.7-1, a project is considered to have no noise impact because on average, the project noise will result in an insignificant increase in the number of people highly annoyed by the new noise. The curve defining impact stops at 65 dBA for Category 1 and 2 land uses (parks and residences) because a number of federal agencies consider 65 dBA as the noise limit for an acceptable living environment. Project noise levels above the upper

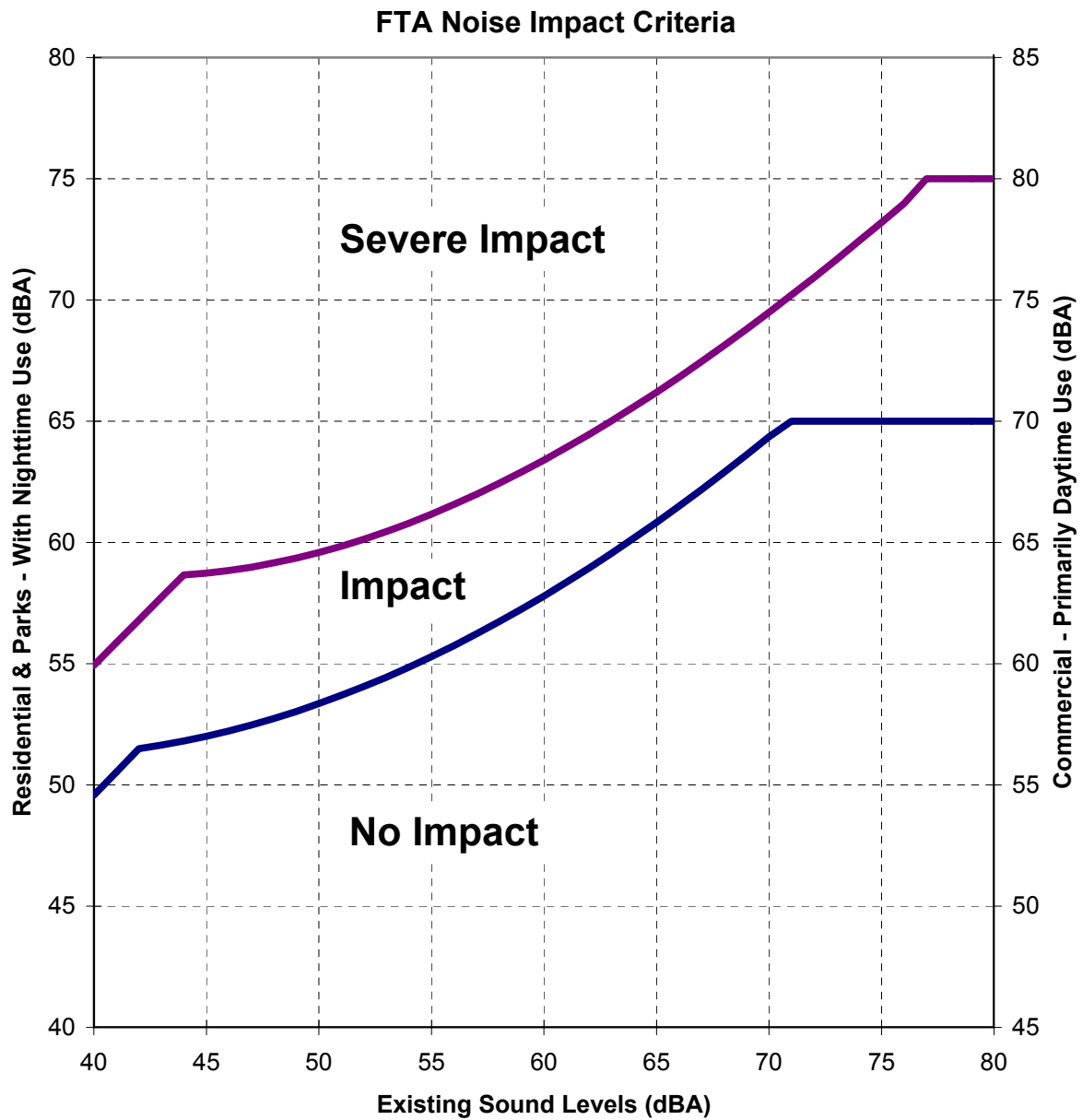


Figure 4.7-1
FTA Noise Impact Criteria

Table 4.7-3. FTA Impact Thresholds for Transit Projects (dBA)

Existing Ldn or Leq	Project-Generated Noise Levels			
	Residential and Other Sensitive Receivers		Commercial Receivers	
	Impact	Severe	Impact	Severe
< 43	Ambient +10	Ambient +15	Ambient +15	Ambient +20
43	52	58	57	63
44	52	58	57	63
45	52	58	57	63
46	53	59	58	64
47	53	59	58	64
48	53	59	58	64
49	54	59	59	64
50	54	59	59	64
51	54	60	59	65
52	55	60	60	65
53	55	60	60	65
54	55	61	60	66
55	56	61	61	66
56	56	62	61	67
57	57	62	62	67
58	57	62	62	67
59	58	63	63	68
60	58	63	63	68
61	59	64	64	69
62	59	64	64	69
63	60	65	65	70
64	61	65	66	71
65	61	66	66	71
66	62	67	67	72
67	63	67	68	72
68	63	68	68	73
69	64	69	69	74
70	65	69	70	74
71	66	70	71	75
72	66	71	71	76
73	66	71	71	76
74	66	72	71	77
75	66	73	71	78
76	66	74	71	79
77	66	74	71	79
> 77	66	75	71	80

Source: FTA (1995) - Table 3-1.

curve in this figure are considered a severe impact because a significant percentage of people would likely be highly annoyed by the new noise. A project noise level between the two curves is an impact under FTA policy, and although not considered severe, may also be significant. Noise in this range would be expected to be noticeable to most people, but may not be sufficient to cause strong adverse reactions from the community. In this transitional area, other factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the predicted noise increase over existing levels and the types and numbers of noise-sensitive land uses that would be affected.

Under FTA criteria, locations with high existing sound levels are not considered affected by the introduction of a new noise source that would not increase the existing level more than minimally. For example, at locations where the existing sound level is 10 dBA or more louder than the noise from the Green Line, the existing level would be unaffected by the addition of the new noise. In locations where the difference in levels is less than 10 dBA, the two noise levels would combine to increase the overall level, possibly to the point of being considered an impact. In locations where the level from a new noise source is the same as existing noise, the overall sound levels would increase by 3 dBA. Under FTA criteria, the determination of impact is based on the overall sound level that would result from the addition of the new noise, and whether that level rises to a level considered an impact. So in some instances where the Green Line noise would be less than existing sound levels, the effect of combining the two levels could increase the overall sound level into the impact range.

The Green Line noise impact analysis used the FTA criteria as the primary basis for assessing the relative significance of noise related to the proposed project alternatives and defined impacts as follows. All potential impacts to non-residential use properties are considered *moderate* impacts because of the temporary exposure for most people using such facilities and the fact that sleep disturbance would not be an issue. Green Line generated sound levels affecting residential uses in areas where the resulting sound levels would remain less than about 65 dBA L_{dn} also are considered moderate impacts. In areas where existing sound levels are near or above 65 dBA L_{dn}, and where project noise would increase the level more than about 0.5 dBA, and in locations where Green Line noise would cause the cumulative noise level to approach, reach, or exceed 65 dBA L_{dn} are considered to have *potential significant impacts*. These terms are used in the following tables and discussions because they are consistent with SEPA designations of the relative significance of potential environmental impacts.

A fairly conservative (i.e., protective) approach was used in assessing the relative significance of potential noise impacts from the Green Line so as to err on the side of caution when identifying potential adversely affected residential locations. It is worth noting that FTA noise impact criteria are based on levels of noise at outdoor locations, with the assumption that indoor levels will be substantially lower, and therefore suitable for habitation, because of the sound reduction provided by building envelopes. It would likely be possible to provide acceptable indoor sound levels even if outdoor levels are too high by adding to the noise-attenuating properties of the building in question. For example, the use of better windows and/or air conditioning can substantially reduce indoor sound levels caused by outdoor sources, and may be used as a form of mitigation.

City of Seattle Noise Limits

Noise from construction of the Green Line would be governed by the timing restrictions and the noise limits included in the Seattle noise ordinance (Seattle Municipal Code, Chapter 25.08). This ordinance includes maximum permissible sound levels based on the zoning of the source and receiving properties (upper portion of Table 4.7-4). With these limits as a basis, the ordinance also sets maximum levels and durations of allowable daytime construction noise. The Seattle construction noise limits are displayed in the lower portion of Table 4.7-4.

Table 4.7-4. Seattle Maximum Permissible Levels and Construction Noise Limits (dBA)

Zoning District of Noise Source [25.08.410 & 420]	Zoning District of Receiving Property		
	Residential Day/Night	Commercial	Industrial
Residential	55/45	57	60
Commercial	57/47	60	65
Industrial	60/50	65	70
Daytime Construction Noise Limits - at 50 feet or a real property line, whichever is greater. <i>Construction noise is limited to the higher levels listed below, during daytime hours only, defined as 7:00 a.m. to 10:00 p.m. weekdays and 9:00a.m. to 10:00 p.m. weekends. These limits effectively prohibit construction at night except in special cases.</i>			
<i>On-site sources</i> , including dozers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, and pneumatic equipment (maximum + 25) [25.08.425 A.1]			
Residential	80	82	85
Commercial	82	85	90
Industrial	85	90	95
<i>Portable</i> equipment used in temporary locations in support of construction, including chain saws, log chippers, and powered hand tools (maximum + 20) [25.08.425 A.2]			
Residential	75	77	80
Commercial	77	80	85
Industrial	80	85	90
<i>Impact types of equipment</i> , including pavement breakers, pile drivers, jackhammers, sand-blasting tools, or other impulse noise sources, may exceed maximum permissible limits between 8:00 a.m. and 5:00 p.m. weekdays and 9:00 a.m. and 5:00 p.m. weekends, but may not exceed the following limits [25.08.425 B]:			
Leq(1 hr) - 90 dBA	Leq(30 minutes) - 93 dBA	Leq(15 minutes) - 96 dBA	Leq(7.5 minutes) - 99 dBA

Source: Seattle Municipal Code - 25.08 - Specific sections indicated.

Section 25.08.425C of the Seattle Municipal Code also prohibits construction noise generated in a commercial district from exceeding the maximum permissible sound levels in Table 4.7-4 in the interior of buildings in commercial districts between the hours of 8:00 a.m. and 5:00 p.m. Compliance with this requirement is intended to be assessed after every reasonable effort, including but not limited to closing windows and doors, has been taken to reduce such noise in the interior space.

Noise from operation of transportation sources is typically exempt from the property-line noise limit provisions of most noise ordinances, which measure the noise from a source property in a particular zone (residential, commercial, or industrial) within a receiving property that may be in another zone. Instead, transportation noise is typically controlled with specific limits using performance standards for levels from new vehicles that can be reasonably met by automobile, bus, and motorcycle manufacturers. The Seattle noise ordinance uses this approach and adopts specific standards for most transportation sources such as new cars, buses, and motorcycles. However, the Seattle ordinance does not have performance standards specific to rail uses such as trolleys, light rail, or monorail. Therefore, the more typically applicable FTA noise impact criteria have been used in this analysis because those criteria provide objective and nationally recognized standards for assessment of impacts for transit projects.

4.7.1.4 Existing Acoustic Environment

The character of the existing acoustic environment in and near the project corridor was assessed with a series of sound level measurements (SLMs) at locations representing sensitive receivers. These 24-hour

measurements document the range of sound levels that occurred over the course of the day of the measurements, and so provide an indication of typical levels in areas that could be affected by monorail noise. All measurements were taken using Type 1 sound level equipment that had been factory certified within the previous 12 months. The SLMs are summarized in Table 4.7-5, and the measurement locations are depicted on Figures 4.7-5 through 4.7-8 included in Section 4.7.2.2.

Table 4.7-5. Measured Existing Sound Levels Representing Residential Receivers (dBA)

Measurement Location	SLM Date	Range of Measured Hourly Leqs		Range of Measured Hourly Lmax		Calculated Ldn
		Daytime	Nighttime	Daytime	Nighttime	
SLM1: 8351 15 th Avenue NW	3/31/03	67-72	59-71	79-99	76-92	73.2
SLM2: 7325 15 th Avenue NW	2/11/02	64-70	57-67	77-91	74-91	70.2
SLM3: 6712 16 th Avenue NW	3/31/03	55-60	45-58	68-79	65-72	60.3
SLM4: 3821 14 th Avenue W	4/7/03	61-65	56-64	68-80	66-84	66.9
SLM5: 505 W Mercer Place	3/26/03	65-70	61-68	72-86	69-84	71.4
SLM6: Second Ave & W Harrison St	2/8/02	55-60	48-56	72-82	64-75	60.5
SLM7: Near 2218 Fifth Avenue	3/31/03	67-78	58-76	82-104	77-103	76.5
SLM8: 2334 Second Avenue	2/9/02	57-64	54-62	71-92	68-86	65.8
SLM9: Pigeon Point	5/19/03	70-74	62-73	81-95	79-94	75.6
SLM10: 2803 SW Yancy Street	3/26/03	59-64	48-58	77-88	65-77	62.6
SLM11: 3249 SW Avalon Way	1/15/02	65-72	52-67	83-101	75-86	69.9
SLM12: 5948 California Avenue SW	3/26/03	62-66	50-62	74-81	70-82	65.5
SLM13: 6708 California Avenue SW	3/31/03	63-69	52-66	75-91	72-80	68.3
SLM14: 2518 SW Genesee St	12/3/03	61-68	52-62	79-101	75-90	65.8

Source: Sound level measurements by MFG, Inc. and SSA Acoustics.

As shown in Table 4.7-5, existing sound levels near almost all portions of the Green Line project area are fairly high. Existing levels at all locations were dominated by traffic noise from nearby roads.

Seattle Center Sound Level Measurements

In addition to the daylong sound level measurements at locations representing residential uses along the Green Line corridor, short-term sound level measurements were taken at outdoor locations at the Seattle Center. These measurements provide indications of existing levels at these outdoor use areas both with and without events at the Seattle Center. These measurements are summarized in Table 4.7-6.

Table 4.7-6. Measured Existing Sound Levels at Seattle Center at Various Times (dBA)

Location	Center Event	Date	Start Time	Duration	Leq	Lmax
Near Fisher Pavilion Roof	None	4/25/03	10:43 ^a	1 hour	57.5	93.1
Fisher Pavilion Roof	Folklife Festival	5/24/03	14:48 ^b	15 min	69.3	84.1
			17:40 ^c	15 min	68.7	94.1
Mural Amphitheater (near center of)	None	4/25/03	9:38	1 hour	58.8	79.0
	Rhythm Festival	4/26/03	11:46 ^d	15 min	55.8	68.3
	Folklife Festival	5/24/03	14:22	15 min	81.0	96.6

Table 4.7-6. Measured Existing Sound Levels at Seattle Center at Various Times (dBA) (continued)

Location	Center Event	Date	Start Time	Duration	Leq	Lmax
audience space)	(during performances)		18:05	15 min	80.1	97.6
			18:20	15 min	82.6	96.5
Near Northwest Rooms	None	4/25/03	12:01	20 min	57.2	88.2
	Folklife Festival (during performances)	5/24/03	13:19	15 min	79.2	92.0
			13:35 ^e	15 min	70.0	80.8
			16:32	15 min	79.9	92.7
			16:48	15 min	76.1	90.3
Lawn Locations Near International Fountain	None	4/25/03	12:09 ^f	20 min	64.9	78.6
	Rhythm Festival	4/26/03	11:26 ^{d, g}	15 min	55.0	84.6
			18:34 ^g	15 min	72.9	102.5
	Folklife Festival	5/24/03	12:56 ^g	15 min	74.5	91.9
			16:10 ^g	15 min	77.8	90.1

^a Roof area of Fisher Pavilion was not yet finished. SLM was taken near south edge of roof area.

^b Near performance venue, but with no performance activity. No HVAC or other mechanical noise was noted during any sound level measurements at this location.

^c With spoken performance at nearby venue.

^d During World Rhythm Festival, but without any activity at this venue or nearby; used as background level.

^e Between performances at nearby stage.

^f On lawn east of fountain; included sound from fountain, people nearby, and some limited construction noise.

^g On lawn north of fountain, with varying levels of activities nearby.

Source: Sound level measurements by MFG, Inc.

4.7.1.5 Vibration Standards and Criteria

The evaluation of vibration impacts uses standards and criteria developed by the Federal Transit Administration (FTA) for assessing vibration impacts related to transit projects. These standards are outlined in *Transit Noise and Vibration Impact Assessment* (FTA, Final Report, April 1995). The *Transit Noise and Vibration Impact Assessment* is the only standard for evaluating vibration impact from operation and construction of a wide range of mass transit projects. No local ordinance addresses structural vibration impact limits for mass transit systems.

The effects of ground-borne vibration from monorail trains to adjacent properties along the Green Line alignments are evaluated. This section focuses primarily on the impacts of operating Green Line trains; construction impacts are discussed in Section 4.17, Construction. The FTA guideline defines acceptable vibration levels depending on the land use category of the adjacent properties for frequent events and provides recommendations for vibration levels not to be exceeded during construction when historic buildings are in close proximity.

Design criteria have been established for High Sensitivity, Residential, Institutional Land Use, Special Buildings, and underground utilities, as well as for construction impacts. The basic concept of ground-borne vibration is that the train tires rolling on the guideway beams create vibration energy that is transmitted through the support structure and into the foundation. The vibration of the foundation creates vibration waves that propagate through adjacent soil and rock strata to the foundation of nearby buildings. The vibration propagates from the foundation throughout the remainder of adjacent building structures.

The vibration criteria for frequent events (more than 70 per day) for different land use categories defined by FTA Guidelines include:

- **Vibration Category 1: High Sensitivity** – Includes buildings where low ambient vibration is essential for the operations within the building. Typical land uses include sensitive research and manufacturing businesses, hospitals with vibration-sensitive equipment, and university research operations. The ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
- **Vibration Category 2: Residential** – Includes all residential land uses and any building where people sleep, such as hotels and hospitals. The ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.
- **Vibration Category 3: Institutional** – Includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. The ground-borne vibration impact limit is 75 VdB re 1 micro inch/sec.
- **Vibration Criteria for Special Buildings** – Includes concert halls, TV and recording studios, auditoriums, and theaters.

Concert Halls	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
TV Studios	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
Recording Studios	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
Auditoriums	Ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.
Theaters	Ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.

- **Construction Vibration Threshold Criteria** – Includes Historic Buildings

Fragile Buildings	Ground-borne vibration impact limit from construction activities is 100 VdB re 1 micro inch/sec.
Extremely Fragile Buildings	Ground-borne vibration impact limit from construction activities is 95 VdB re 1 micro inch/sec.

Extremely fragile buildings include historic brick buildings with a high risk of cracking. The construction vibration impact limits are approximate thresholds above which architectural damage could occur in some of the extremely fragile buildings.

4.7.1.6 Existing Vibration Measurements

The Green Line is an elevated street railway that would have rubber-tired vehicles traveling along elevated guideway beams supported by columns. Concrete pre-cast guideways would have a 5- to 7-foot depth and span between approximately 60 to 150 feet or greater for bridges or other special structures where needed. Expansion columns with expansion gaps between sections of guideway would be designed every third to sixth column to absorb dimensional changes, such as those caused by thermal expansion. Column foundations would be between 6 to 12 feet in diameter, with depths varying from 30 to greater than 100 feet depending on subsurface conditions. Green Line vehicles would travel at a maximum speed of 50 mph.

An elevated transportation system using pneumatic rubber tires and smooth concrete guideways, coupled with ground damping, would result in lower vibration levels when comparing elevated grade systems to at grade systems. The smoothness of the concrete guideway and the distance of the support structure to the closest receiver are the critical factors. The rubber tires plus the concrete columns together with ground damping (depending on soil type and conditions) and coupling losses between the ground and the foundation would provide a high degree of vibration damping.

This section analyzes structural vibration impacts from Green Line operation using the FTA standards for comparison purposes. Construction impacts are analyzed in Section 4.17, Construction. The study uses vibration data collected from the existing Seattle Center Monorail system as the vibration source levels with no reduction for new train or guideway design. Using the existing Seattle Center Monorail for vibration source data results in a conservatively high estimate of vibration impacts from the Green Line operations because existing monorail vehicles are over 40 years old, and newer vehicle technology would generate less vibration. In addition, modern construction techniques of the Green Line guideway would result in smoother and less frequent expansion gaps between sections of guideway compared to the existing monorail system, also resulting in lower vibration. The existing Seattle Center Monorail has expansion gaps at every column compared to every three to six columns for the proposed Green Line. Monorail vehicles traveling over these expansion gaps create the largest vibration levels based on the source data collected.

4.7.1.7 Vibration Measurement Setup and Descriptors

Existing vibration measurements of the existing Seattle Center Monorail system were taken to establish source levels for structural vibration. The measured vibration levels are a conservatively high estimate of the future vibration impact from the Green Line trains. Improvements to the train's suspension system and guideway construction will reduce the overall vibration levels for new monorail systems, due primarily to the smoothness of the guidebeam surface and the reduced number and size of the expansion gaps, which are the main sources of vibration. In addition, all measurements have been taken at a maximum speed of 50 mph for the impact analysis. In most locations, the Green Line trains would be traveling at lower speeds, thereby generating lower vibration levels than analyzed using the source data in this section.

All measurements are root mean square (RMS) velocity levels expressed in velocity dB, abbreviated VdB. Vibration velocity levels in decibels are defined as:

$$L_v = 20 \times \log_{10} (V/V_{ref})$$

L_v - velocity level in VdB

V - RMS velocity amplitude

V_{ref} - reference velocity amplitude

The reference vibration velocity used throughout this section is 1 micro inch per second (micro inch/sec).

Because the net average of a vibration signal is zero, RMS amplitude is used to describe the smoothed vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal. The average is typically calculated over the measurement period (duration of 30 seconds), similar to how the human body responds to an average vibration amplitude.

Although the vibration perceptibility threshold is about 65 VdB, human response to vibration is not usually significant unless the vibration exceeds 70 VdB (Figure 4.7-2).

65 VdB	Approximate threshold of perception for many humans.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

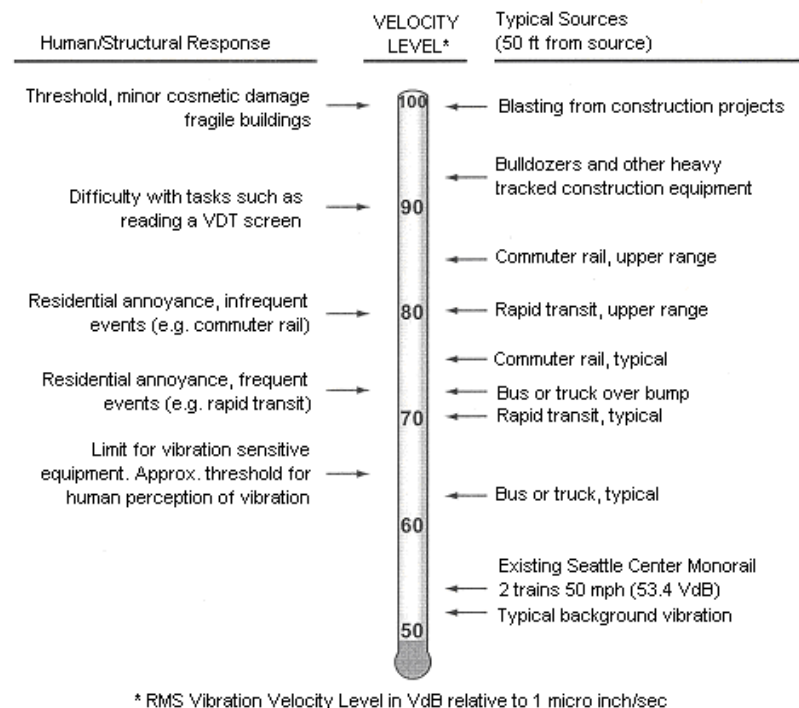
All transducers used for the vibration measurements were attached using magnetic bases coupled to a 2-by 2-inch steel plate and glued to the measured surface with industrial adhesive. The surfaces were clean and flat to provide optimal coupling between the transducers and test surfaces. Measurements were conducted with two transducers simultaneously.

Measurements along the existing monorail were taken on April 3, 2003. A summary of the results is presented in Table 4.7-7. A comprehensive set of vibration measurements for different system operating characteristics was taken as follows:

- At maximum vehicle speed (50 mph) at a guideway discontinuity (expansion gap).
- At a turn with the train going 30 mph.
- At a station with the train at maximum braking and acceleration.
- At different distances from the support column to assess how much source vibration is transmitted through support columns and into the adjacent ground.

The vibration velocity levels of typical sources would increase by 12 VdB re 1 micro inch/sec if the distance between source and receiver is reduced to 10 feet.

Figure 4.7-2. Typical Levels of Ground-Borne Vibration



Source: *Transit Noise and Vibration Impact Assessment* (FTA, Final Report, April 1995).

Measurements taken on top of the guideway support column with the train at maximum speed (50 mph) passing an expansion gap showed the highest vibration levels and have been used for the vibration impact predictions. The vibration damping levels measured at different distances away from a support column were found to be higher than published data. Therefore, these measurement results have not been used for the vibration impact assessment. Instead, the published “Generalized Ground Surface Vibration Curves” from the FTA Guidelines have been used to provide an estimate of vibration impacts.

Projected vibrations were developed based on measurements of existing monorail vehicles approaching and departing a station and were adjusted to reflect typical maximum speeds (50 mph) for the Green Line. Basing the analysis on train speeds of 50 mph is very conservative, as the average speed of the Green Line trains will be lower at most locations and therefore would also generate lower vibration impact than the model predictions.

Table 4.7-7. Existing Seattle Monorail Vibration Levels

Location	Vibration Level (VdB)	
	Ambient	with Train at 50 mph
Guideway/expansion gap	53.6	78.2
Column base	55.7	68.0
5 feet from base	53.3	62.9
10 feet from base	53.2	59.4
20 feet from base	51.8	53.3
30 feet from base	52.1	52.4
40 feet from base	50.7	50.9
50 feet from base	51.2	51.3
100 feet from base	49.8	49.8
Mid span between columns 38 and 39	58.7	72.3
Turn/expansion gap	54.1	74.4
Station EMP maximum braking	55.3	68.8
Station EMP maximum acceleration	55.3	68.9

Note: All measurements were taken for a duration of 30 seconds.

4.7.1.8 Methodology for Estimating Vibration from Green Line Operations

To estimate vibration levels from Green Line operations, a scenario reflecting the maximum possible vibration levels was developed. This scenario assumed two trains passing a column with expansion gaps simultaneously at a maximum speed of 50 mph. Existing vibration measurements have identified a train passing the expansion gaps as being the most severe vibration impact from Green Line operations. Predictions of ground-borne vibration levels at different distances from the centerline of the track are shown in Table 4.7-8.

Table 4.7-8. Predicted Source Vibration Levels

Description	Direction	Vibration Level
Two trains at 50 mph in opposite directions at guideway/expansion gaps	Vertical	84.2 VdB
Column base with two trains at 50 mph	Vertical	74.0 VdB
5 feet from face of base with two trains at 50 mph	Vertical	69.4 VdB
10 feet from face of base with two trains at 50 mph	Vertical	65.4 VdB
20 feet from face of base with two trains at 50 mph	Vertical	61.4 VdB
30 feet from face of base with two trains at 50 mph	Vertical	58.4 VdB
40 feet from face of base with two trains at 50 mph	Vertical	55.4 VdB
50 feet from face of base with two trains at 50 mph	Vertical	53.4 VdB
100 feet from face of base with two trains at 50 mph	Vertical	46.4VdB

RMS velocity levels, VdB re 1 micro inch/sec.

The predicted vibration levels in Table 4.7-8 are a conservatively high estimate of vibration levels from Green Line operations. The impact scenario evaluates the maximum theoretical vibration impact from two trains under the above conditions. In reality, it would be very unlikely for two Green Line trains to simultaneously pass a column with expansion gaps at the maximum 50 mph speed. This maximum speed can only be achieved on long, straight guideway sections with long enough spacing between stations to provide sufficient distance for accelerating and braking.

During the majority of time during Green Line operations, the structural vibration levels would be well below the stated maximums shown in Table 4.7-8. For example, one train going over an expansion gap would lower vibration levels by 6 VdB re 1 micro inch/sec compared to two trains passing at the same time. Worn out and brittle concrete has resulted in the removal of the steel flashing plates, which alters the expansion gap geometry on the existing Seattle Center Monorail. Newer train technology and construction design could reduce these factors, therefore reducing vibration levels.

Predictions for vibration damping with distance have been taken from the *FTA Transit Noise and Vibration Impact Assessment, Final Report* April 1995, Figure 10-1, "Generalized Ground Surface Vibration Curves" for Rubber-Tired Vehicles (30 mph). The curves in Figure 4.7-3 have been developed from numerous measurements of ground-borne vibration levels from rubber-tired vehicles at different distances, in different subsoil conditions. The curves represent the upper range of the measurement data, which means that although actual vibration levels show a 10 VdB re 1 micro inch/sec fluctuation depending on the subsurface conditions and coupling effects, it is rare that ground-borne vibration would exceed the vibration levels shown in these curves. Exceedances have only been documented in extenuating circumstances, such as rail corrugations or wheel flats not applicable for rubber-tired systems such as a monorail. As ground damping values do not change with the speed of a vehicle, the curve for rubber-tired vehicles at 30 mph can be applied to a system with 50 mph train speeds.

Damping versus distance values have been established for various setbacks from the Green Line using Figure 4.7-3. These values have been used to develop the predicted vibration impact levels at different distances from the alignment shown in Table 4.7-8. The source levels for Table 4.7-8 have been taken from the actual measurements at the column base of the existing monorail. Predicted future ground-borne vibration levels from the Green Line are shown in Figure 4.7-4. The predicted vibration levels stated in Figure 4.7-4 are conservatively high since the vibration levels assumed two trains passing over an expansion gap at the same time, at higher speeds than the Green Line would typically use, and used measurements from the 40-year-old existing Seattle Center Monorail. The actual vibration levels from the Green Line operation would be lower at almost all times and locations.

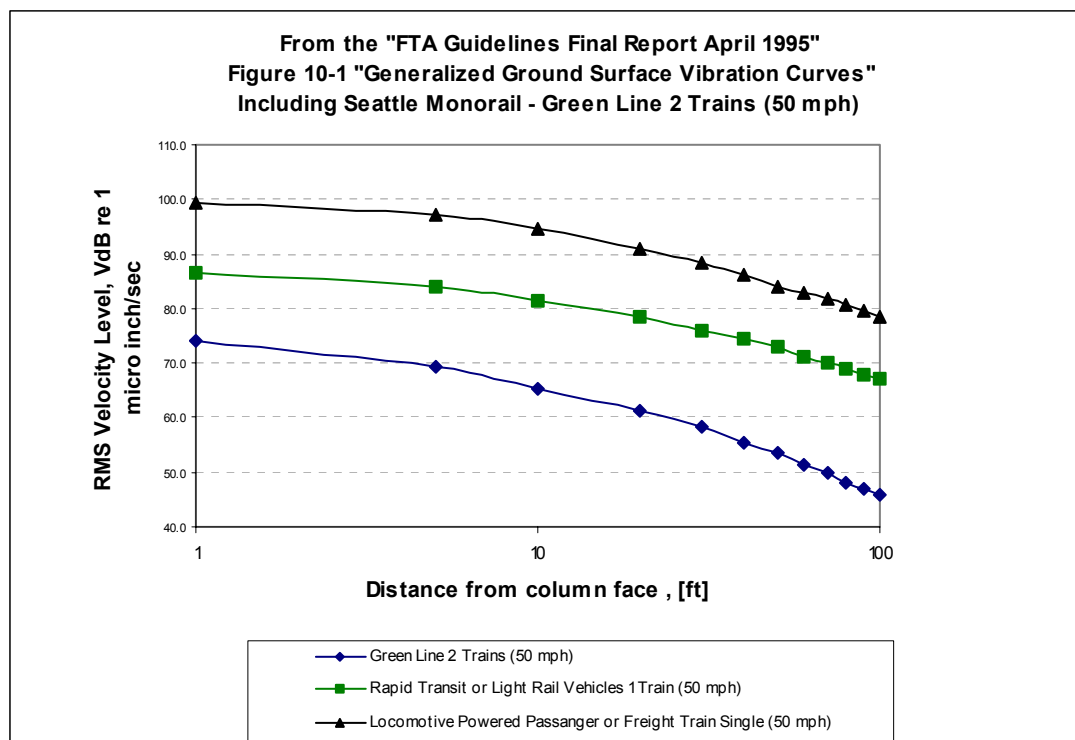
4.7.1.9 Inventory of Vibration-Sensitive Sites

The following buildings located in close proximity to one or more Green Line alternative alignments have been identified as land uses with a high sensitivity to structural vibration. The FTA vibration impact criteria have been used to identify sensitive receivers as specified in Vibration Category 1, High Sensitivity and Special Buildings.

Vibration Category 1: High Sensitivity – Included in Category 1 are buildings where low ambient vibration is essential for the operations within the building, which may be well below levels associated with human annoyance. Typical land uses covered by Category 1, High Sensitivity, are vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations.

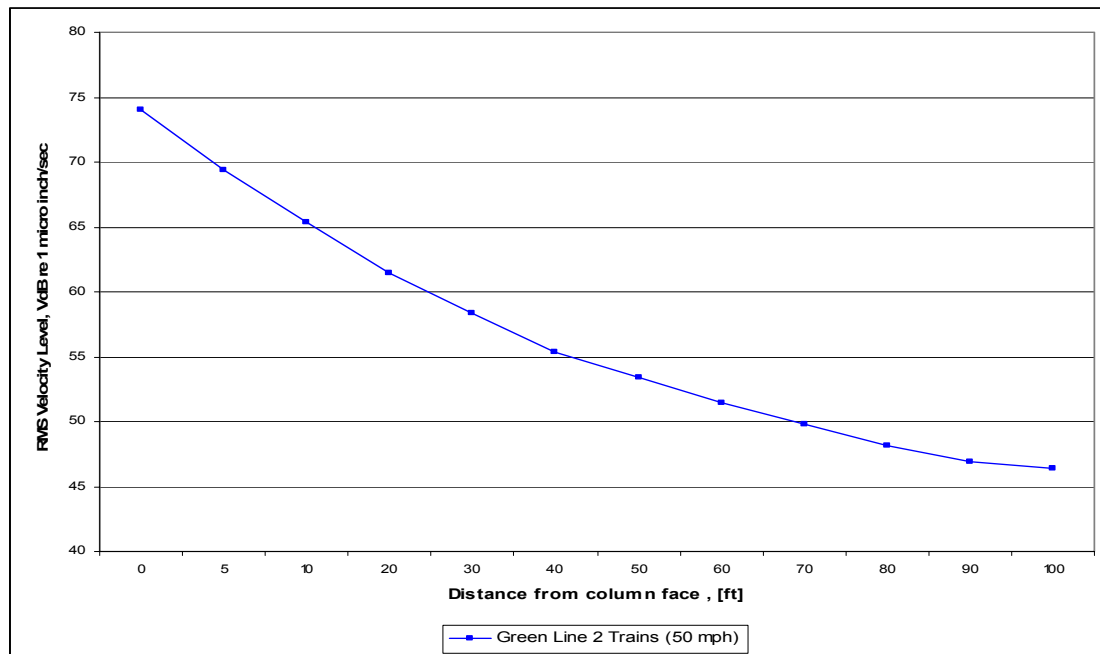
Vibration Criteria for Special Buildings – There are some buildings that do not fit into the High Sensitivity category, but because of the sensitivity of the buildings, they usually warrant special attention. Typical buildings covered by Category 2, Special Buildings, are concert halls, TV and recording studios, and theaters.

Figure 4.7-3. General Ground Surface Vibration Curves



Source: FTA "Transit Noise and Vibration Curves" for Rubber-Tired Vehicles.

Figure 4.7-4. Ground Surface Vibration Curve for the Green Line



There are four High Sensitivity buildings along the Green Line alternative alignments, three located in the Interbay/Magnolia Segment and one located in the Queen Anne/Seattle Center/Belltown Segment:

- Friedman & Bruya, Inc. Environmental Chemists at 3012 16th Avenue W. This building is located south of W Dravus Street and is approximately 20 and 100 feet away from Alternatives 2.1 and 2.2, respectively.
- Immunex/Amgen Campus at 1555 W Galer Street. This campus is located west of Elliott Avenue W south of the Magnolia Street Bridge and Galer Street overpass. The campus is approximately 250 to 200 feet away from Alternatives 2.1 and 2.2, respectively.
- Cell Therapeutics Inc. at 501 Elliott Avenue W. This business is located on the west side of Elliott Avenue W and is approximately 40 and 20 feet away from Alternatives 2.1 and 2.2, respectively.
- Pacific Biometrics Inc. at 220 W Harrison Street. This business is located on the north side of W Harrison Street, and is approximately 40 and 10 feet away from Alternatives 3.1 and 3.2 respectively.

Other facilities defined as Special Buildings located in close proximity to the Green Line alternative alignments include:

- Marion Oliver McCaw Hall at Seattle Center
- Seattle Repertory Theater at Seattle Center
- Intiman Playhouse at Seattle Center
- Seattle Children's Theater at Seattle Center
- Experience Music Project (EMP) at Seattle Center

- Fisher Pavilion at Seattle Center
- Moore Theater in Downtown Seattle
- Seattle Art Museum in Downtown Seattle
- Benaroya Hall in Downtown Seattle
- Arts West Theater in West Seattle

In addition to these High Sensitivity and Special Buildings, historic structures listed or eligible for listing in the National Register of Historic Places (NRHP) and City of Seattle landmark properties adjacent to the Green Line alternative alignments were also evaluated for construction vibration impacts.

Historic buildings can be categorized into Extremely Fragile Buildings and Fragile Buildings; however, not all historic buildings listed or eligible for listing in the NRHP are fragile. The FTA Guidelines Final Report from April 1995 does not provide specific guidance on how to define and categorize Fragile or Extremely Fragile Historic Buildings. From experience of similar projects and a seismic classification of different types of structures, the following categories have been assumed for this analysis:

- Extremely Fragile Buildings – Un-reinforced masonry, large un-reinforced concrete block, and old load-bearing timber structures with preexisting cracks in facade, with missing pieces of brick or plaster. Overall bad conditions, not well maintained property.
- Fragile Buildings – Un-reinforced masonry, large un-reinforced concrete block, load-bearing timber structures. No visible cracks in facade, well maintained, overall good condition.
- Not Fragile Buildings – Pre-cast concrete, well-maintained wood, or steel structures.

All historic properties have been evaluated and categorized using drawings where available and visual inspection. A list of historic buildings including classification is included in Table 4.17-6, Historic Resources and Construction Vibration Impact from Pile Driving.

4.7.2 Impacts

4.7.2.1 Operational Noise Impacts Related to Green Line Stations

Noise sources at Green Line stations would include the operation of trains, onboard equipment, and people entering and leaving the trains. As Green Line trains enter and leave stations, they must brake and then accelerate. With properly functioning trains, the process of starting and stopping does not generate much if any excess noise because the trains are powered by electric motors, and there is no engine noise as there is with equipment powered by internal combustion. In addition, stopping and starting are very short-term events.

When Green Line trains are not moving, there would be no noise related to tire movement, which is the primary noise source at speed. So while stopped at stations, the only noise from a train would be generated by onboard compressors that provide air to pressurize the hydraulic systems (e.g., for opening and closing the doors) and by the heating, ventilation, and possible air-conditioning (HVAC) systems. Each car would be equipped with compressors, but may or may not have HVAC systems. While the compressors and HVAC systems generate fairly low levels of noise that would probably be unnoticed by most users passing through the stations, this equipment generates sufficient noise to be potentially problematic at residential uses very near the stations. Based on the source noise measurements of the Disney World monorail described previously, the estimated noise from a stopped Green Line train is 51

dBA L_{dn} at a distance of 50 feet. Using this estimate, it is possible to calculate the approximate levels of noise from a stopped train at more distant locations like the off-site residences as described below.

Potential noise impacts from trains stopped at stations were assessed by screening the alternative station locations to identify the presence of nearby sensitive receivers (residences). For purposes of this screening, a distance of about 160 feet from the center of the station was used. (Refer to Appendix R, Noise and Vibration Backup Information in the Draft EIS, for more information.) After screening eliminated station locations with no nearby potentially affected receivers, a more detailed station noise analysis was used to identify potentially affected receiving locations. For this secondary analysis, the running Green Line train sound levels predicted with the Traffic Noise Model were added to the estimated idling noise from each station to determine the overall Green Line train-related sound levels at nearby sensitive receivers. This overall monorail noise was then compared to the FTA impact criteria based on the representative existing L_{dn} at each location. This analysis determined that the estimated Green Line train sound levels at residential locations near the vast majority of stations would either not be affected by idling noise, or would not experience a noise impact from the combined running and stopped noise. Only two potential station locations were identified as having residential locations nearby that could be affected by the inclusion of stopped Green Line train noise. These two stations are shown in Table 4.7-9. The station modifications and new stations added since the Draft EIS, including those associated with the Preferred Alternative did not change this conclusion.

Table 4.7-9. Estimated Noise Levels Near Two Alternative Monorail Stations (dBA)

Station	Existing L _{dn}	Station Idling Noise	Running Noise (from TNM)	All Green Line Train Noise (Idling + Running)	FTA Impact Level
Fifth and Stewart 3 (Lenora)	74	60	65	66	66
Pike 1	66	56	60	62	62

Source: MFG, Inc.

The overall noise level at the residential receivers closest to both these locations just exceeds the FTA impact level. Note that the estimates of idling noise are conservative, and the actual overall Green Line sound level may be lower than shown for the following reasons.

- The moving train noise estimated by the Traffic Noise Model (TNM) did not include the trains slowing to a complete stop at the stations. Therefore, the predicted running noise sound levels very near the stations are somewhat overestimated.
- The Green Line stations may themselves include some amount of structure that could obstruct noise transmitted from the stopped trains to the potentially affected residences. Because detailed design information for the stations was not available at the time of this analysis, it was not possible to conclusively determine any potential barrier reductions.
- The train that provided the basis of the equipment noise levels while stopped did not represent the same level of technology in either the noisy equipment (e.g., compressors and pumps) or the sound control applications that are available today.
- Idling noise measured from existing systems includes some elements (such as air conditioning) that may not be included on the Green Line.

Station Bus Layover Areas

All stations also would be serviced by nearby bus routes, and in some instances, bus routes and bus layover areas would be modified to improve service to Green Line passengers. (Bus layovers are already commonly used in many areas along the Green Line alternative alignments.) This would in some cases relocate bus traffic and bus stop zones near the stations and would create new bus stops and new bus layover areas. Such facilities could have noise impacts on nearby residential uses.

Based on review of all the potential bus layover areas, it was concluded that noise from buses at five of the possible layover areas associated with four stations has the potential to impact nearby residential receivers. These include the layover areas associated with the Dravus 1B, Delridge 1, Delridge 4, Avalon 2A, , and the Alaska Junction 2 stations. Potential noise impacts associated with these three possible facilities were assessed using the FTA transit noise assessment spreadsheet and representing the layover areas as “transit centers.” It was assumed this calculation treated the bus sources as pass-through traffic that included some amount of idling. This would be a reasonable representation of the layover area operation unless such layovers do not occur during all hours of the day. The results of this review are described below.

Dravus 1B (east of 16th Avenue W): This bus layover area would be along the east or west side of 16th Avenue W, within about 100 feet of several existing homes. At this distance, and assuming the existing noise environment at this location that is fairly well shielded from direct exposure to traffic on 15th Avenue W, noise from bus layovers could cause potentially significant impacts at these homes. These potential noise impacts would require further monitoring and possible mitigation measures if bus layover activities occur at this location.

Delridge 1 (26th): This bus layover area would be approximately 60 feet from the nearest residences just south of the possible layover area. Up to seven buses could access this location at any one time. Assuming seven buses per hour would use the layover area each hour between 5:00 a.m. and midnight, the FTA spreadsheet predicts an L_{dn} of 62 dBA at the nearest residences. This could constitute a potentially significant noise impact according to FTA criteria, depending on the levels of existing noise at these residences. This potential noise impact will require further monitoring if bus layover activities occur at this location. Such impacts could very likely be controlled by site design and timing considerations (e.g., the actual layover area location, possible noise barrier, and whether buses idle for prolonged periods).

This bus layover area would be located outside the current street right-of-way, so noise from this facility could be subject to the City of Seattle noise limits. The site is zoned for industrial uses and the receiving residences are in a residential zone, so the day and night noise limits are 60 and 50 dBA, respectively. Given that the Green Line is expected to operate during nighttime hours (i.e., between 10:00 p.m. and midnight and between 5:00 and 7:00 a.m.), the more stringent noise limit would be the nighttime limit of 50 dBA. The calculated hourly Leq, assuming seven buses use the layover area in any one-hour period, is 59 dBA. This predicted hourly sound level exceeds the 50-dBA nighttime limit, and noise mitigation would likely be necessary to meet the City noise limits if this site is chosen. The possible mitigation measures mentioned in the preceding paragraph also would be effective in allowing noise from this facility to meet the Seattle noise limits.

Delridge 4 (Genesee): This bus layover area would be located on the north side of SW Dakota Street just west of Delridge Way SW, approximately 40 feet from the nearest residence. Up to seven buses could access this location at any one time. Assuming seven buses per hour would use the layover area each hour between 5:00 a.m. and midnight, the FTA spreadsheet predicts an L_{dn} of 67 dBA at the nearest residence. This would likely constitute a potentially significant noise impact according to FTA criteria,

depending on the levels of existing noise at this residence. This potential noise impact would require further monitoring and possibly mitigation if bus layover activities occur at this location.

Avalon 2A (35th): This bus layover area would be sited on 35th Avenue SW, approximately 38 feet from an apartment building with 28 units. Up to four buses could use the site at any one time. Assuming that 4 buses per hour would use the layover area between 5 a.m. and midnight, the FTA spreadsheet calculated an Ldn of 65 dBA at the nearest residences. This could constitute a potentially significant impact using FTA criteria depending on existing sound levels at the units facing the layover area. This possible noise impacts would require further monitoring and possibly mitigation if these layover areas are chosen.

Alaska Junction 2 (44th/California): This bus layover area could be as close as 35 feet to the nearest residence. Up to five buses could use the site at any one time. Assuming three buses per hour would use the layover area between 5 a.m. and midnight, the FTA spreadsheet estimates an Ldn of 67 dBA at the nearest residences. This could constitute a potentially significant noise impact under FTA criteria, depending on the levels of existing noise at these residences. This potential noise impact would require further monitoring and possible mitigation measures if bus layover activities at this location.

Traction Power Substations

The Green Line would use traction power substations along the route to provide electrical power to the monorail. These units are small power substations, and thus involve transformers that emit noise. The power equipment at each substation would be completely enclosed in some form of building designed to minimize the transmission of transformer noise to the outdoor environment to the degree warranted by the local setting of each substation. For that reason, noise from these units would not be expected to cause noise impacts.

These traction power substations also could require the use of cooling or ventilation equipment that would generate noise. Noise from such equipment would be controlled to the extent necessary to comply with the applicable sound level limits in the Seattle noise rule.

Crossover Switches

The previously considered dual beam configuration alternatives would include several crossover switches to allow trains to move from one guideway to the other. The single beam portions of several alternatives and of the Preferred Alternative would include numerous switches to allow the trains to pass at stations and other locations. Switches are movable sections of the guideway up to about 100 feet long that would most likely be hydraulically operated devices, with the hydraulics pressurized by electric pumps. The pumps and the hydraulic equipment would create some noise. The guideway switches were not specifically considered in the noise analysis because based on practical observations by train experts Lea + Elliott (L+E), switches are believed to be a minor noise source compared with operational noise from the trains.

Because the switches are electrically powered and hydraulic, they are quieter than trains. Train engineering firms that work on these types of switches, as a matter of course, report that switches produce less noise than typical background levels in an urban setting. So in most locations, and at most times of day, switch noise would likely be masked by noise from existing sources. At quiet times, such noise could be noticeable, but it would likely still be a minor source compared with the noise from the moving trains. Consequently, switches would not be likely to be major contributors to the noise environment.

Switch sections of the guideway would likely include an additional under-guideway structure, probably made of concrete. This additional structure would create a partial barrier to noise created by the switches,

and also could provide the opportunity to add noise control for switching equipment, should this be determined to be necessary. Although impacts from switch noise are not anticipated, SMP's overall noise monitoring program would evaluate switch noise after the Green Line begins operations, and mitigation measures would be implemented if needed. Similar to train noise, the noise from switches would be monitored after Green Line construction, and noise shielding could be added to the switches if desirable. Unlike trains, switches are stationary and readily lend themselves to a noise shielding mitigation solution.

4.7.2.2 Operational Noise Impacts From Green Line Alternatives

The noise impact analysis completed for this Final EIS included additional modeling to supplement the modeling reported in the Draft EIS. The purpose of this modeling was to more closely examine the potential impacts associated with the Preferred Alternative that was designated after receiving comments on the Draft EIS. This latest effort also updated some of the modeling conducted for the Draft EIS using the latest available design information.

The impact analysis results reported below thus include the "old" and the "new" noise modeling. In most cases, the modeling for the Preferred Alternative is reported in the same tables as the results of the previous modeling. In these cases, the Preferred Alternative is highlighted in the tables. But the reader is advised that modeling for the Preferred Alternative is not necessarily directly comparable to the results of the previous modeling for the reasons explained in the methods portion of this section. The latest modeling for the Preferred Alternative uses refined assumptions about travel speeds and monorail headways that were not employed in the previous modeling.

Segment 1: Ballard Segment

The Ballard Segment of the Green Line was considered as four subsections based on the varying average speeds across the segment. The modeling results for the Ballard Segment are summarized in Table 4.7-10A and discussed following the table. The modeling receptors considered in this table are displayed in Figure 4.7-5. The potential for impacts is indicated in the columns labeled "Modeled Impact" in which the calculated monorail noise is compared with FTA noise impact criteria. Cells marked as either *Moderate* or *Potentially significant* denote locations that could be affected by noise from the Green Line.

The modeling results for the evaluation of Ballard Segment of the Preferred Alternative are presented in Table 4.7-10B. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the impacts discussion in this section.

Table 4.7-10a. Noise Impact Analysis Results - Ballard Segment

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1		Alternative 1.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
NW 85 th Street to NW 80 th Street 25 mph	1	73	54	No Impact	51	No Impact
	2	72	64	No Impact	55	No Impact
	3	60	54	No Impact	52	No Impact
	4	72	55	No Impact	55	No Impact
	5	55	51	No Impact	51	No Impact

Table 4.7-10a. Noise Impact Analysis Results - Ballard Segment (continued)

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1		Alternative 1.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
NW 80 th Street to NW 65 th Street 50 mph	6	72	74	Potentially significant	65	No Impact
	7	70	66	Potentially significant	62	No Impact
	8a	60	60	Moderate	53	No Impact
	8b	72	65	No Impact		No Impact
	9	72	63	No Impact	65	No Impact
	10a	56	59	Moderate	60	Moderate
	10b	72	63	No Impact	58	No Impact
NW 65 th Street to NW Market Street 45 mph	11	70	61 ^a	No Impact	58	No Impact
	12	72	69	Potentially significant	62	No Impact
	13	70	61	No Impact	59	No Impact
	14	60	59	Moderate	57	No Impact
	15	67	57	No Impact	57	No Impact
	16	59	55	No Impact	55	No Impact
NW Market Street to Ship Canal 50 mph	17	70	64	No Impact	61	No Impact
	18	63	61	Potentially Significant	58	No Impact

^a Existing sound level adjusted to reflect removal of building shielding some receivers in this area. Previously predicted impacts at locations represented by this receptor were in error.

Source: Modeling and calculations by MFG, Inc.

Table 4.7-10b. Noise Impact Analysis Results - Ballard Segment: Alternative 1.1(s)

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1(s) - Preferred	
			Monorail Leq/Ldn	Modeled Impact
NW 85 th Street to NW 80 th Street 15 mph	1	73	48	No Impact
NW 80 th Street to south of NW 77 th Street 50 mph	2	72	70	Potentially significant
	3	60	60	Moderate
	4	72	61	No Impact
	5	55	55	No Impact
S. of NW 77 th Street to NW 67 th Street 40 mph	6	72	65	No Impact
	7	70	59	No Impact
	8a	60	54	No Impact
	9	72	57	No Impact
	10a	56	53	No Impact
	10b	72	57	No Impact
NW 67 th Street to NW 63 rd Street 15 mph	8b	72	53	No Impact
	11	70	50	No Impact
NW 63 rd Street to NW 52 nd Street 15 – 40 mph	12	72	61	No Impact
	13	70	51	No Impact
	15	67	48	No Impact
	16	59	47	No Impact
	14	60	49	No Impact
	17	70	59	No Impact
NW 52 nd Street to Ship Canal 50 mph	18	63	60	Potentially significant

Note: A new and more refined speed profile was used in the modeling of the Preferred Alternative. Receivers may therefore be in slightly different groupings than in the previous analysis represented in the previous table.

Source: Modeling and calculations by MFG, Inc.

Alternative 1.1 - West Side of 15th Avenue NW

NW 85th Street to NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.1 alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th and 80th Streets.

NW 80th Street to Ship Canal. Modeling indicates operation of the Green Line on the Alternative 1.1 alignment would cause noise impacts in the subsection of the Ballard Segment between NW 80th and the Ship Canal. FTA noise impact criteria suggest potentially significant noise impacts at all first row residential receivers west of the alignment in this section and moderate impact levels of noise at most second row residential receivers west of the road and at second row receivers east of and within 140 feet of the road.

Alternative 1.1(s) - West Side of 15th Avenue NW single beam – Preferred Alternative

NW 85th Street to North of NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.1(s) alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th Street and north of NW 80th Street.

North of NW 80th Street to South of NW 77th Street. Modeling indicates operation of the Green Line on the Alternative 1.1(s) alignment would cause noise impacts between just north of NW 80th Street and just south of NW 77th Street. Potentially significant noise impacts could occur at all first row receivers, and moderate impacts at all second row receivers west of the road.

NW 77th Street to NW 52nd Street. Modeling indicates the Alternative 1.1(s) alignment of the Green Line would not impact receivers between just south of NW 77th Street and NW 52nd Street.

NW 52nd Street to NW 51st Street. Modeling indicates the Alternative 1.1(s) alignment of the Green Line would cause potentially significant noise impacts between NW 52nd Street and NW 51st Street at first-row receivers west of the roadway.

Alternative 1.2 - Center of 15th Avenue NW

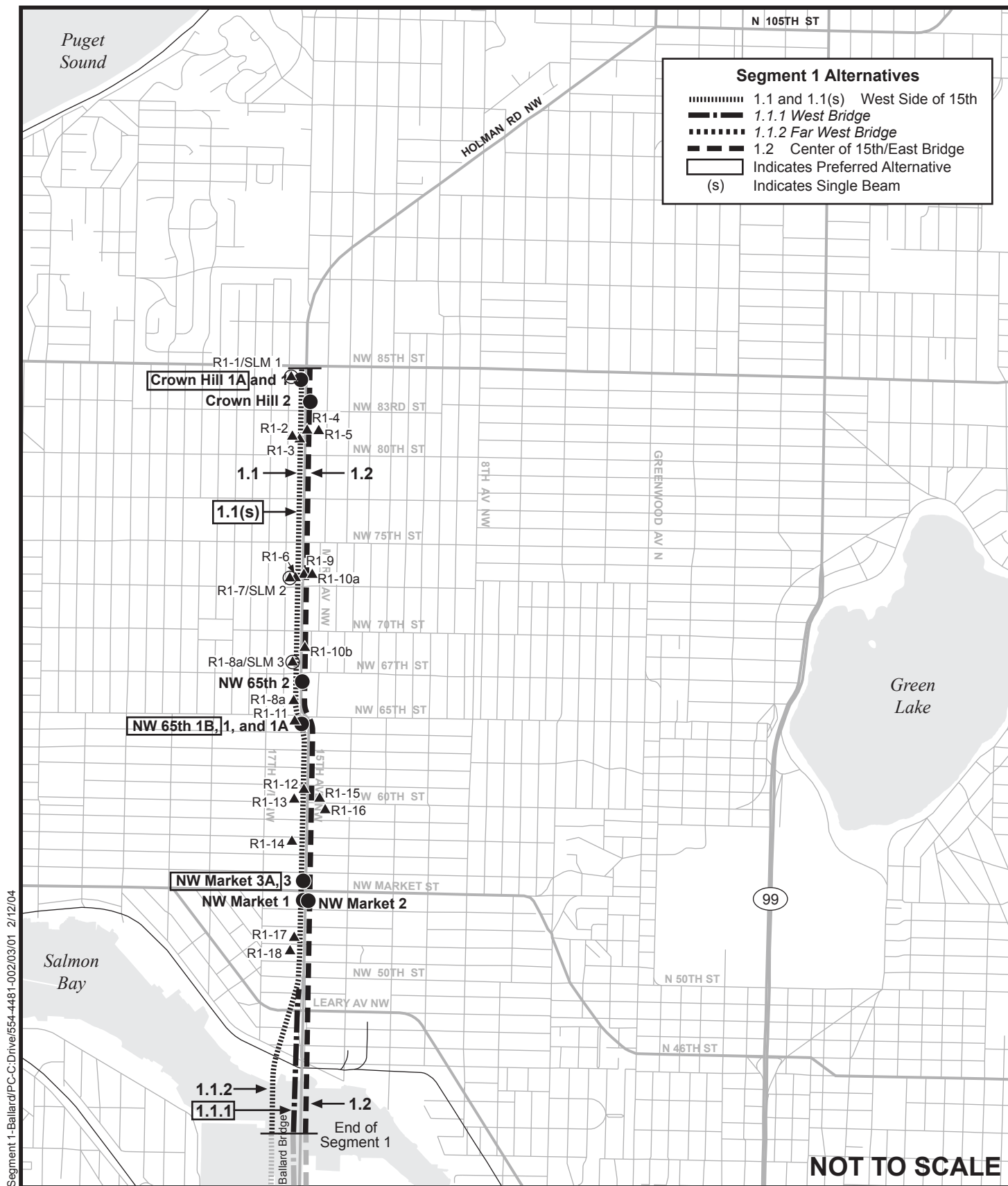
NW 85th Street to NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.2 alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th and 80th Streets.

NW 80th Street to NW 65th Street. TNM modeling indicates Alternative 1.2 of the Green Line would cause moderate noise impacts in the subsection of the Ballard Segment between NW 80th and NW 65th Streets. Modeling predicts moderate noise impacts at second row receivers east of and within 140 feet of the road.

NW 65th Street to Ship Canal. TNM modeling indicates Alternative 1.2 of the Green Line would not impact residential receivers in the subsection of the Ballard Segment between NW Market Street and the Ship Canal.

Ballard Segment: Preferred Alternative

In Ballard, Alternative 1.1(s), a single beam configuration on the west side of 15th Avenue NW, has been designated as the Preferred Alternative. Noise impacts for the Preferred Alternative in Ballard are expected to be about the same or somewhat less than for Alternative 1.1 (which would feature a dual



Segment 1-Ballard/PC-C:Drive/554-4481-002/03/01 2/12/04



R1-1/SLM 1 Receptor and SLM
R1-2 Receptor

Figure 4.7-5
Segment 1: Ballard
SLM and Model Receptor Locations

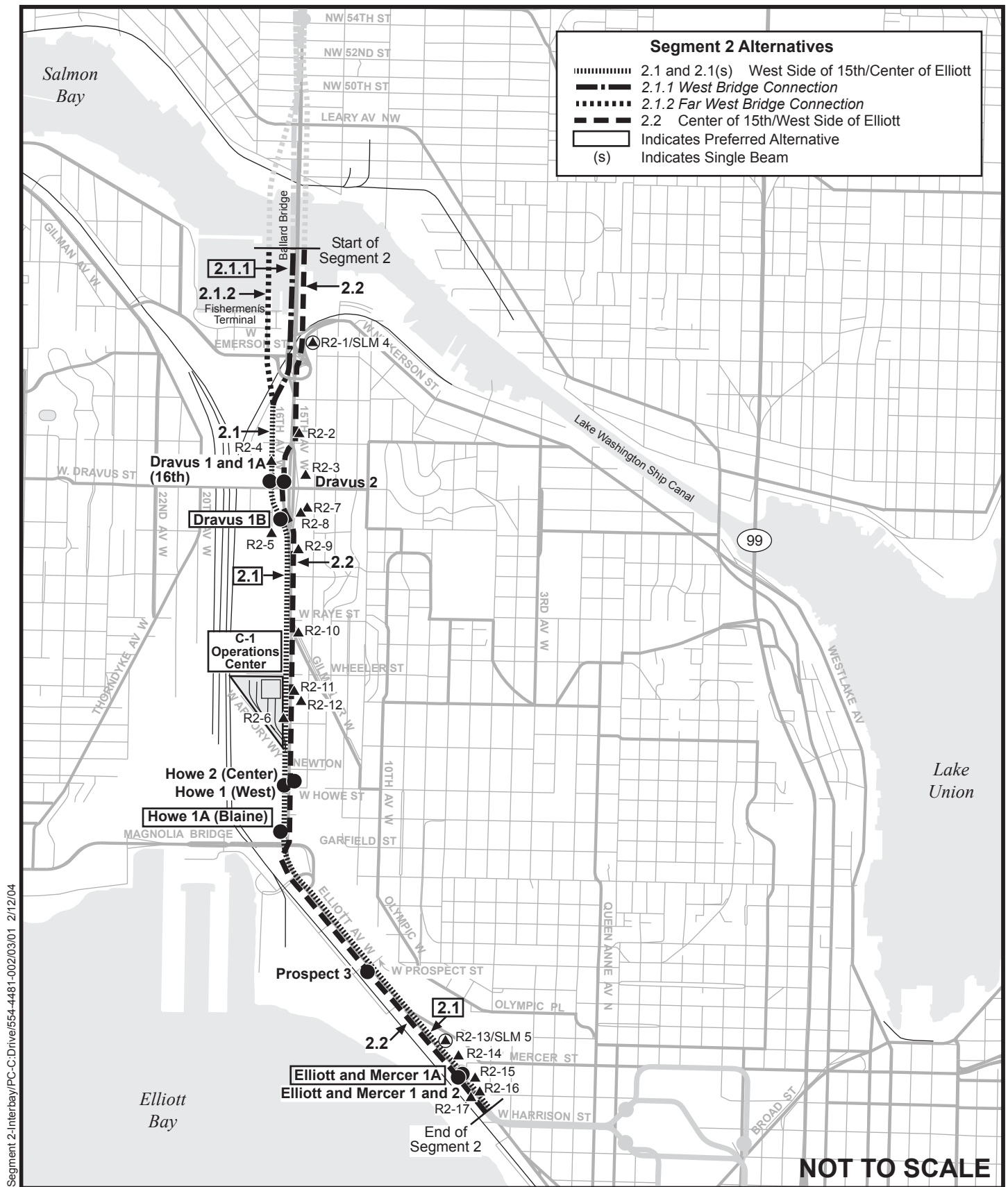
Table 4.7-11. Noise Impact Analysis Results - Interbay/Magnolia Segment

Segment Subdivision	Receptor #	Existing Ldn	Alternative 2.1 - Preferred		Alternative 2.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
Ship Canal to W Dravus Street 40 mph	1	70	50	No Impact	55	No Impact
	2	70	45	No Impact	57	No Impact
	3	63	42	No Impact	53	No Impact
	4	62 ^(a)	53 ^(a)	No Impact	53 ^(a)	No Impact
W Dravus Street to W Mercer Place 50 mph	5	62 ^(a)	52 ^(a)	No Impact	54 ^(a)	No Impact
	6	65 ^(a)	67 ^(a)	No Impact	63 ^(a)	No Impact
	7	63	46	No Impact	54	No Impact
	8	67	47	No Impact	55	No Impact
	9	74	57	No Impact	64	No Impact
	10	73	59	No Impact	61	No Impact
	11	74	62	No Impact	64	No Impact
	12	63	55	No Impact	57	No Impact
W Mercer Place to W Mercer Street 35 mph	13	71	51	No Impact	50	No Impact
	14	73	52	No Impact	53	No Impact
W Mercer Street to W Harrison Street 30 mph	15	71	49	No Impact	51	No Impact
	16	76	54	No Impact	53	No Impact
	17	70 ^(a)	52 ^(a)	No Impact	60 ^(a)	No Impact

^a Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Source: Modeling and calculations by MFG, Inc.

NOTE: Single beam alternative, 2.1(s), was not evaluated with modeling. However, because of the similarities of the alignments, noise impacts would not be expected with Alternative 2.1(s) based on results of modeling Alternatives 2.1 and 2.2.

Source: Modeling and calculations by MFG, Inc.



Segment 2-Interbay/PC-C:Drive/654-4481-002/03/01 2/12/04



R2-1/SLM 4 Receptor and SLM
R2-2 Receptor

Figure 4.7-6
Segment 2: Interbay/Magnolia
SLM and Model Receptor Locations

beam configuration on the west side of 15th Avenue NW), but somewhat more than for Alternative 1.2 (which would travel above the center of 15th Avenue NW, and thus be farther from homes west of the road than the Preferred Alternative).

Segment 2: Interbay/Magnolia Segment

The Interbay Segment of the Green Line was considered as four subsections based on the varying average speeds along the alignment alternatives. The modeling results for the Interbay Segment are summarized in Table 4.7-11 and discussed following the table. The modeling receptors considered in Table 4.7-11 are displayed in Figure 4.7-6.

Alternative 2.1 – West Side of 15th/Center of Elliott – Preferred Alternative

Noise impact modeling indicates the Alternative 2.1 alignment of the Green Line through the Interbay Segment would not cause noise impacts at any of the residential, recreational, or commercial locations considered.

Alternative 2.1(s) – Single Beam, West Side of 15th/West Side of Elliott

The Alternative 2.1(s) alignment of the Green Line was not examined using noise modeling, however noise impacts are not expected from this alternative through the Interbay Segment, based on other modeling results that indicate no impacts for any of the proposed Interbay/Magnolia alignments.

Alternative 2.2 - Center of 15th/West Side of Elliott

Modeling indicates the Alternative 2.2 alignment of the Green Line through the Interbay Segment would not cause noise impacts in the Interbay Segment.

Interbay/Magnolia Segment: Preferred Alternative

In Interbay/Magnolia, Alternative 2.1 has been designated as the Preferred Alternative. Noise modeling indicates there would be no noise impacts in Interbay from operation of the Green Line along the Preferred Alternative route.

Interbay Operations Center Alternative

The Interbay Segment includes one of two possible locations for an Operations Center. The Interbay facility, recommended as part of the Preferred Alternative, would include maintenance, storage, operations control, and offices. The potential Operations Center location in this segment is on a triangular site between 15th Avenue W, W Wheeler Street, and W Armory Way. Green Line trains would access the site via guideways at W Armory Way, connecting to the mainline guideway along 15th Avenue W. For the connections to the mainline guideway, switches and crossover tracks would be required.

Noise from the Operations Center would be subject to the limits in the Seattle noise ordinance (see Table 4.7-4), and the residential limits would have to be met at the residential receivers east across 15th Avenue W of the potential Operations Center site. Noise control is one of many factors that would be considered in the ultimate design of this facility at this site. Noise occurring within this facility (e.g., light and heavy vehicle maintenance) would be substantially controlled by the structure of the building.

Much of the maintenance activity would likely involve relatively little noise. Louder activities would include such things as use of pneumatic tools and banging on metal that could result in temporary increases in noise in nearby, unshielded locations. Given the north/south alignment of the Green Line, the Operations Center would likely be oriented with its major openings facing north and/or south. There are

no residential receivers within 500 feet either directly north or south of this site. The closest residential uses are to the east, across 15th Avenue W, and these receivers are subject to high levels of traffic noise from this road.

The closest residence is approximately 250 feet east of the closest portion of the site where the Operations Center could be located. The estimated existing sound level at this residential location is 71 dBA L_{dn}. Under FTA criteria, it would take an L_{dn} level of 66 dBA from equipment noise to cause a noise impact. At a distance of 250 feet, pneumatic tools or banging on metal would produce noise levels less than 60 dBA, assuming there would not be direct line-of-sight exposure to the noise sources. Assuming such noise occurred all day and night, the resulting L_{dn} level at 250 feet (without direct line-of-sight) would be about 64 dBA. Because such maintenance activity would not occur consistently over a 24-hour period, the actual L_{dn} from such activity would likely be much lower, and thus would not cause an impact under FTA criteria.

The City of Seattle noise limits are based on the zoning of the noise source and the receiving properties. The proposed Interbay Operations Center site is on property zoned for industrial use, and the closest residences east of 15th Avenue W and adjacent to the roadway are in a commercial zone. The Seattle noise limit for industrial sources affecting commercial receivers is 65 dBA day and night, and the estimated sound levels at 250 feet (at locations without direct line-of-sight) of less than 60 dBA. Such levels would comply the City of Seattle noise limits.

Because maintenance operations noise could be effectively controlled, and given the distances to the closest sensitive receivers, noise from the proposed Interbay Operations Center would be expected to both comply with Seattle noise limits and to avoid noise impacts under FTA criteria.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Queen Anne/Seattle Center/Belltown Segment of the Green Line was considered as four subsections that included the alternative alignments on all sides of the Seattle Center along with a number of receptor locations to consider Green Line noise on the Center grounds. The modeling receptors considered in this table are displayed in Figure 4.7-7. The results of the modeling for the Queen Anne/Seattle Center/Belltown Segment are displayed in Table 4.7-12. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section. Potential noise impacts at indoor and outdoor venues at the Seattle Center also were examined as part of this analysis as described later in this section.

Alternative 3.1 - Seattle Center/Republican – Preferred Alternative

W Harrison Street to First Avenue N. Modeling indicates all three Green Line alternative alignments traversing from Elliott Avenue W to First Avenue N could cause moderate to potentially significant noise impacts at first row residential locations along the north and south side of W Harrison Street. Second row residential buildings would not be impacted. In the Draft EIS, the Dalmasso Apartments building was assumed to be displaced by this alternative, and therefore would not experience any noise impacts. But, guideway profiles used in this Final EIS would have the Green Line fly over the building, thus resulting in potentially significant noise impacts, which could be potentially mitigated.

Seattle Center Area. The Alternative 3.1 alignment would not impact any other residential receivers in this segment. This alternative also would not impact outdoor use areas in the Seattle Center either during non-festival times or during large festivals. During quiet times in the Center, the Green Line would be clearly audible at outdoor locations near the Northwest Rooms and on the lawn north of the International Fountain, but Green Line noise would not substantially increase sound levels over the existing acoustic environment. Locations near the International Fountain are at times dominated by sounds from the

Table 4.7-12. Noise Impact Analysis Results - Queen Anne/Seattle Center/Belltown Segment

Segment Subdivision	Rec #	SLM #/ Location	Existing Leq/Ldn	Alternative 3.1 – Preferred ^a		Alternative 3.2		Alternative 3.3		Alternative 3.5	
				MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
W Harrison to Queen Anne Avenue N 30 - 40 mph	1	SLM 6	61	61	Moderate	63	Potentially significant	64	Potentially significant	62	Potentially significant
	2		61	52	No Impact	55	No Impact	57	No Impact	58	No Impact
Queen Anne Avenue N to Vine Street 25 - 30 mph	3		63	59	No Impact	62	Potentially Significant	66	Potentially significant	66	Potentially significant
	4		63	63	Potentially Significant	65	Potentially Significant	61	Potentially significant	61	Potentially significant
	5	Center Near Northwest Rooms	57 ^b	51	No Impact	57 ^b	Moderate				
			70 ^b	51	No Impact	57 ^b	No Impact				
			80 ^b	51	No Impact	57 ^b	No Impact				
	6	Center Fountain Lawn	55 ^b	50	No Impact						
			73 ^b	50	No Impact						
			78 ^b	50	No Impact						
	7		70			63	No Impact				
	8a	Center House School	60 ^c	50 ^{b,d}	No Impact						
	8b	Off-site School	58 ^b					57 ^b	Moderate	52 ^b	No Impact
	9	Church	58 ^b					57 ^b	Moderate	57 ^b	Moderate
	10	Center Fisher	58 ^b					54 ^b	No Impact	48 ^b	No Impact
			69 ^b					54 ^b	No Impact	48 ^b	No Impact
	11	Center Mural	56 ^b					51 ^b	No Impact		
			80 ^b					51 ^b	No Impact		
Vine Street to Wall Street 15 - 40 mph	12		73	62	No Impact	63	No Impact	65	No Impact	59	No Impact
	13	SLM 7	73	52	No Impact	60	No Impact	60	No Impact	60	No Impact
	14		73	58	No Impact	60	No Impact	59	No Impact	59	No Impact
	15		73	61	No Impact	63	No Impact	65	No Impact	59	No Impact

^a Alternative 3.1 is highlighted as the Preferred Alternative. The Preferred Alternative actually includes portions of Alternatives 3.1.1, 3.1.4, and 3.2.1, not listed in the table. The number of noise impacts that would result from these alternatives would be the same as Alternative 3.1.

^b Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate receptor locations that are too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

^c This estimate of existing levels is from an SLM in a more shielded location that is not subject to the same levels of noise from the existing amusement park (including a roller coaster) that dominates the exterior acoustic environment at the windows on the third and fourth floors of these school rooms

^d Also represents Alternative 3.1.2.

Source: Modeling and calculations by MFG, Inc.

fountain, including splashing water, recorded music, and at times, screaming children. Close to the fountain, these noises would continue to dominate the acoustic environment. During performances at typical outdoor venues, and especially at locations near the stage (i.e., where people typically sit), sound levels from stage acts are usually much louder than the levels that would be expected from the Green Line. It is therefore unlikely that Green Line noise would interfere with most performances in outdoor venues at the Seattle Center.

Noise modeling also was used to examine the noise implications of the Alternative 3.1 and 3.1.2 alignments on sound levels outside the Center School classrooms on the third and fourth floors of the Seattle Center House. Judging from a visit to this facility, existing sound levels in these classrooms are dominated by HVAC noise when these rooms are otherwise quiet. The interior acoustic environment would be dominated by conversational sounds or music when these rooms are in use as classrooms. When the windows are closed, noise from outside is mostly inaudible except close to the windows; when the windows are open, noise from the roller coaster and other amusement park rides is at times clearly audible. The noise modeling analysis indicated the two alignment alternatives would have little or no effect on exterior sound levels near these classrooms. This means the Green Line also would have little or no effect on interior sound levels in these classrooms.

Seattle Center Interior Performance Venue Impact Assessment

Concern was raised by operators of both indoor and outdoor performance venues at the Seattle Center regarding the potential for noise from the Green Line to affect activities in these venues. The potential for noise impacts at these venues was assessed using sound level measurements of activities in several outdoor venues for comparison with predicted monorail noise at these same venues. Results of this analysis are discussed above in relation to various alternative alignments' potential to affect outdoor venues at the Center.

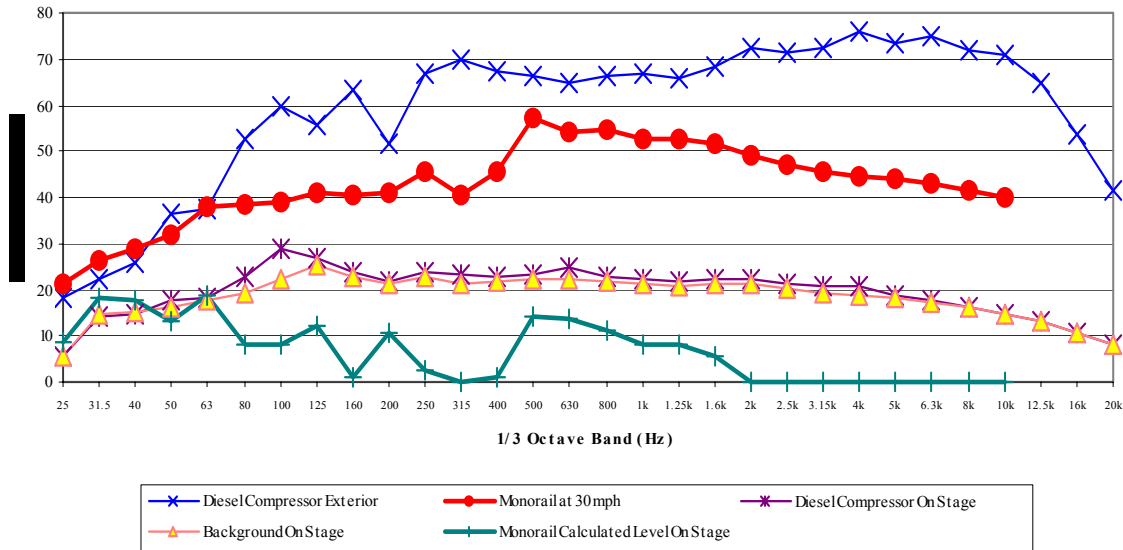
Additionally, the potential for effects at two indoor venues was assessed using data from several simultaneous interior/exterior measurements with a loud noise source running outside. These measurements were taken at interior spaces in both the Intiman and Leo K. Theaters and outdoors closer to the sound source, while the sound source (a large diesel compressor) was positioned at (or closer than) the approximate location of the Alternative 3.1 alignment near the theaters. The sound attenuation provided by the respective buildings was then assessed using measured sound levels inside and outside with and without the diesel compressor running. Comparing noise from the compressor with the noise from the Green Line, it was possible to evaluate the potential for monorail noise to affect interior performance spaces at the Center. Refer to Appendix R, Noise and Vibration Backup Information, for additional information regarding the details of this assessment.

Based on the measurements at the Intiman and Leo K. Theaters, it is clear that noise from the Green Line traveling at an average speed of 25 mph would not be likely to affect interior sound levels at any of the interior performance venues at the Center. As shown in Figure 4.7-8, noise from the Green Line would be less than measured background levels on the stage of the facility, and thus would most likely be inaudible. The lowest line in this chart represents the calculated level of monorail noise based on the expected outdoor level minus the noise reduction provided by the building envelope (based on these measurements). Because the monorail sound levels are less than the background levels measured in this theater when it was completely empty, noise from the monorail would be unlikely to be audible, especially when the theater is filled with people and the background level is much higher. In point of fact, noise from the diesel generator used in these tests was inaudible in the interior space even though the sound raised the background levels slightly during these measurements.

Denny Way to Lenora Street. The Green Line Alternative 3.1 alignment would not impact any residential receivers in these subsections of the Queen Anne/Seattle Center/Belltown Segment.

Other alternative alignments within this subsection, including Alternatives 3.1.1, 3.1.2, and 3.1.4, would not result in noise impacts at any residential, recreational, or commercial locations. Modeling results for these alternatives were not included in Table 4.7-12 to simplify the presentation of the analysis

Figure 4.7-8 Intiman Theater Stage Interior/Exterior Levels Using Diesel Compressor and Monorail Sound Level Measurements



Alternative 3.2 - Mercer

W Harrison Street to First Avenue N. Alternative 3.2 also could cause potentially significant impacts at first row residential locations along the north and south side of W Harrison Street. Second row residential buildings would not be impacted. The Dalmasso Apartments is the only residential building north of the road in this subsection.

Seattle Center Area. The Alternative 3.2 alignment could cause moderate noise impacts at outdoor use locations near the Northwest Rooms in the Center during low-use periods when background sound levels are low. During periods of more intense use, as during major festivals, sound levels from performance venues near the Northwest Rooms would be much louder than Green Line noise, so little if any impact would be expected. The Alternative 3.2 alignment would not affect existing residential uses along Mercer Street because Green Line noise would be far overshadowed by existing noise from the high traffic volumes along Mercer.

Denny Way to Lenora Street. The Green Line Alternative 3.2 alignment would not impact any residential receivers in this subsection of the Queen Anne/Seattle Center/Belltown Segment.

Other alternative alignments within this subsection, including Alternatives 3.2.1, 3.2.2, and 3.2.3, would not result in noise impacts at any residential, recreational, or commercial locations. Modeling results for these alternatives were not included in Table 4.7-12 to simplify the presentation of the analysis.

Alternative 3.3 - Thomas

W Harrison Street to First Avenue N. Alternative 3.3 could also cause potentially significant noise impacts at first row residential locations along the south side of W Harrison Street west of Queen Anne Avenue N and at first row receivers north of W Harrison Street and west of First Avenue N. The slight southward shift in this alignment could cause potentially significant noise impacts at the first row residential receivers south of W Harrison Street between Queen Anne Avenue N and First Avenue N. Second row residential buildings would not be affected.

Seattle Center Area. Modeling indicated the Alternative 3.3 alignment would not affect any outdoor use locations in the Seattle Center, but could cause moderate impacts at both the school and the church south of Thomas Street and east of Second Avenue N just outside the Center.

Denny Way to Lenora Street. The Alternative 3.3 alignment would not impact any residential receivers in this portion of the Queen Anne/Seattle Center/Belltown Segment.

Alternative 3.5 - Second/Denny

W Harrison Street to First Avenue N. The Alternative 3.5 alignment could cause potentially significant noise impacts at first row residential locations along the south side of W Harrison Street west of Queen Anne Avenue N, as well as first row receivers north of W Harrison Street and west of First Avenue N. The slight southward shift in this alignment would cause potentially significant noise impacts at the first row residential receivers south of W Harrison Street between Queen Anne Avenue N and First Avenue N. Second row residential buildings would not be affected.

Seattle Center Area. The Alternative 3.5 alignment would not cause impacts at any outdoor use locations in the Seattle Center, but could cause moderate impacts at the Sacred Heart Church south of Thomas Street and east of Second Avenue N just outside the Center.

Denny Way to Lenora Street. The Alternative 3.5 alignment would not cause impacts at any residential receivers in this portion of the Queen Anne/Seattle Center/Belltown Segment.

Queen Anne/Seattle Center/Belltown Segment: Preferred Alternative

In Queen Anne/Seattle Center/Belltown, portions of Alternatives 3.1, 3.1.1, 3.1.4, and 3.2.1 have been designated as the Preferred Alternative. The noise impact analysis indicates that the Preferred Alternative – as with all other alternatives studied – could cause impacts to first row residential locations on W. Harrison Street. Based on the refined alignment and speed profile used with the Preferred Alternative, it would have fewer impacts along the south side of W Harrison Street than the other alternative alignments because of the indicated slower travel speeds near one of the otherwise impacted residential receivers. All alternatives would cause potentially significant noise impacts at the Dalmasso Apartments; potential mitigation measures for this location would be evaluated in a subsequent review.

Within the Seattle Center, the Preferred Alternative would not impact outdoor use areas in the Seattle Center either during non-festival times or during large festivals, and would not be likely to impact interior performance spaces at the Center. The Alternative 3.2 alignment could cause moderate impacts at performance venues near the Northwest Rooms, and Alternatives 3.3 and 3.5 could cause moderate impacts at off-site receivers that would be close to these respective alignments. Finally, no noise impacts would be expected along Fifth Avenue through Belltown with any of the project alternatives.

Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment of the Green Line was considered as four subsections. Results of the modeling are summarized in Table 4.7-13, and the modeling receptors considered in this table are displayed in Figure 4.7-7. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section.

Alternative 4.1 - West Side of Second

North of Virginia Street. Modeling indicates none of the Downtown Segment alternatives would impact residential receivers north of Virginia Street.

Virginia Street to Pike Street. Modeling indicates that Alternative 4.1 would not impact any receivers in this segment subsection.

Pike Street to Marion Street. Modeling indicates that Alternative 4.1 could cause potentially significant noise impacts at the residential receivers represented by receptor 5, which is the north end of the Newmark building west of Second Avenue between Pike Street and Union Street.

Marion Street to Yesler Way. Modeling indicates none of the Green Line alternative alignments would impact any receivers in this subsection of the Downtown Segment.

Options 4.1.1 and 4.1.2 to Alternative 4.1

Modeling suggests these alternative alignments would have the same noise effects as Alternative 4.1, and would only potentially significantly impact the residential receivers in the north end of the building west of Second Avenue between Pike Street and Union Street.

Table 4.7-13. Impact Analysis Results - Downtown Segment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 4.1, 4.1.2 - Preferred		Alternative 4.2		Alternative 4.3	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
North of Virginia Street 35 mph	1	74	60	No Impact	65	No Impact	61	No Impact
Virginia Street to Pike Street 25 mph	2	66	52	No Impact	55	No Impact	52	No Impact
	3	66	52	No Impact	63	Potentially significant	54	No Impact
	4	66	56	No Impact	54	No Impact	55	No Impact
Pike Street to Marion Street 40 mph	5	66	61	Potentially significant	54	No Impact	58	No Impact
	6	69 ^a	52 ^a	No Impact	66 ^a	Moderate	60 ^a	No Impact
Marion Street to Yesler Way 35 mph	7	69 ^a	57 ^a	No Impact	62 ^a	No Impact	60 ^a	No Impact
	8	69 ^a	51 ^a	No Impact	58 ^a	No Impact	59 ^a	No Impact

^a Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers.

Source: Modeling and calculations by MFG, Inc.

Alternative 4.2 - East Side of Second with Crossover

Alternative 4.2 would shift noise impacts from the west to the east of Second Avenue and could potentially cause significant impacts at the residential building at the north end of the block between Pine and Pike Streets in the subsection between Virginia and Pike Streets. This alternative could also cause a moderate noise impact at the outdoor Garden of Remembrance at Benaroya Hall east of Second Avenue between Union Street and University Street.

Alternative 4.3 - Center of Second

Modeling suggests this alternative alignment would have less potential to cause noise impacts than Alternatives 4.1, 4.1.2, and 4.2, and would not cause impacts at any residential receivers.

Alternative 4.4 – East of Center on Second

Although Green Line Alternative 4.4 was not evaluated with noise modeling, this alternative closely matches the alignment of Alternative 4.2 (traversing the east side of Second and then crossing over to the west side of Second near Marion Street) that was considered with noise modeling. Along the east side of Second, Alternative 4.4 would be slightly closer to the centerline of the roadway, and farther away from receivers east of the road. Consequently, there would be no potentially significant impact at R4-3, as is predicted for Alternative 4.2. There would be a moderate noise impact at receptor R4-6. No other noise impacts are expected with Alternative 4.4.

Downtown Segment: Preferred Alternative

In the Downtown Segment, Alternative 4.1 with 4.1.2 option in the Fifth and Stewart area has been designated as the Preferred Alternative. This alignment would be expected to cause potentially significant noise impacts at some residences along Second Avenue that would not be expected with a center of street alignment (Alternative 4.3). This alignment would result in about the same impacts as the 4.2 east side alignment, just on the other side of the street. Note that the assessment for the Preferred Alternative conducted for the Final EIS included shorter headways in the downtown turn back area (i.e., more trains during peak periods) than the other alternatives, so direct comparisons are not appropriate.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Due to the absence of sensitive noise receivers in the SODO Segment, no noise impacts would be expected. This segment was not examined using noise modeling. Likewise, the possible use of a site in this area for an Operations Center was not specifically considered in the noise analysis. But given the lack of sensitive receivers in the vicinity, it is unlikely this alternative for an Operations Center would result in noise impacts.

Segment 6: West Seattle Segment

The West Seattle Segment of the Green Line was considered as five subsegments, with additional subsections within each subsegment, as necessary. Results of the modeling are summarized in Tables 4.7-14A, 4.7-14B, 4.7-14C, 4.7-14D, and 4.7-14E, and the modeling receptors considered in these tables are displayed in Figure 4.7-9. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section. For each West Seattle subsegment, the noise modeling results are presented in separate tables, and discussed following the tables.

Table 4.7-14a. Impact Analysis Results - West Seattle Segment – Duwamish Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1.1		Alternative 6.1.2		Alternative 6.2	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
West Seattle Bridge to 22 nd Avenue SW 40 mph	1	76	55	No Impact	62	No Impact	55	No Impact
	2	73	53	No Impact	58	No Impact	54	No Impact

NOTE: The Preferred Alternative is not highlighted in this table because it was not evaluated with modeling. An explanation of the Preferred Alternative in the Duwamish Subsegment, Alternative 6.1(s), is presented below.

Source: Modeling and calculations by MFG, Inc.

Alternative 6.1.1 - West Seattle Duwamish Subsegment - Past Pigeon Point

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.1.1 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1.2 - West Seattle Duwamish Subsegment - Near Pigeon Point

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.1.2 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1(s) - West Seattle Duwamish Subsegment - Past Pigeon Point – Single Beam – Preferred Alternative

West Seattle Bridge to 22nd Avenue SW. Noise modeling was not conducted for this alternative near Pigeon Point, so this alternative is not represented in Table 4.7-14A. However, based on modeling results of all other alternatives, noise impacts would not be expected at any receivers in this subsegment for Alternative 6.1(s), the Preferred Alternative of the Green Line alignment.

Alternative 6.2 - West Seattle Duwamish Subsegment New Monorail Bridge

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.2 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1 - West Seattle Delridge Subsegment – South of Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the south side of SW Yancy Street between 28th Avenue SW and 30th Avenue SW (Receptor 13). Modeling also indicates the potential for moderate impacts at a commercial location along Delridge Way SW (Receptor 3), and at a recreational facility (Longfellow Creek, represented by Receptor 4). No other noise impacts are expected.

Alternative 6.2 - West Seattle Delridge Subsegment – North of Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that Alternative 6.2 of the Green Line alternative alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.3(s) - West Seattle Delridge Subsegment – Nucor Alternative – Preferred Alternative

Delridge Way SW to SW Yancy Street. Noise modeling was not conducted for this alternative alignment, so it is not included in Table 4.7-14B. However, because there are no sensitive receivers in the

Table 4.7-14b. Impact Analysis Results - West Seattle Segment – Delridge Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.2		Alternative 6.4		Alternative 6.5	
			MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact
22 nd Avenue SW to 30 th Avenue SW 35 mph	3	79 ^a	66 ^a	Moderate	49 ^a	No Impact	48 ^a	No Impact	62 ^a	No Impact
	4	64 ^a	62 ^a	Moderate	53 ^a	No Impact	53 ^a	No Impact		
	5	72 ^a	53 ^a	No Impact	64 ^a	No Impact	57 ^a	No Impact		
	11	67	56	No Impact	50	No Impact	48	No Impact	53	No Impact
	12	70	59	No Impact	50	No Impact	49	No Impact	57	No Impact
	13	63	62	Potentially Significant	53	No Impact	59	No Impact		
	14	60	56	No Impact	50	No Impact	54	No Impact		
Genesee Alternative Delridge Way SW to SW Avalon Way	G1	64							62	Potentially Significant
	G2	64							58	No Impact
	G3	58							53	No Impact
	G4	58							54	No Impact
	G5	64							62	Potentially Significant
	G6	64							59	No Impact
	G7	66							61	No Impact
	G8	62							54	No Impact
	G9	66							57	No Impact
	G10	61							50	No Impact
	G11	66							61 ^a	No Impact
	G12	66							59	No Impact
	G15	66							51	No Impact
	G16	62							53	No Impact
	G13	66							54	No Impact
	G14	61							49	No Impact

^a Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

NOTE: The Preferred Alternative is *not* highlighted in this table because it was not evaluated with noise modeling. A discussion of the Preferred Alternative in the Delridge Subsegment, Alternative 6.3(s), is presented below.

Source: Modeling and calculations by MFG, Inc.

vicinity of this alternative, noise impacts would not be expected at any residential, recreational or commercial locations in this subsegment of Alternative 6.3(s), the Preferred Alternative of the Green Line alignment.

Alternative 6.4 - West Seattle Delridge Subsegment – Past Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that Alternative 6.4 of the Green Line alignment would not cause impacts at any receivers in this subsegment. The speed profile through this subsegment used to model Alternative 6.4 for the Final EIS was somewhat more refined than the speed profile used for the Alternative 6.1 modeling conducted for the Draft EIS because updated information was available for use in the later modeling. Although the alignments of Alternative 6.1 and 6.4 are very similar near R-13, the more refined speed profile modeling indicated impacts would not occur at this receiver. But even without a different speed profile, the 6.1 alignment would include a straight guideway section past receptor R-13, while the 6.4 alignment would include two nearby curves that would keep travel speeds somewhat lower than with the straight section. With the slower travel speed past this location, the potential for impacts would be reduced.

Alternative 6.4(s) - West Seattle Delridge Subsegment – Single Beam Past Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling was not conducted for this alternative in this subsegment, so it is not included in Table 4.7-14B. However, based on modeling results for Alternative 6.4, noise impacts would not be expected at any receivers in this subsegment of the Green Line alignment.

Alternative 6.5 - West Seattle Delridge Subsegment – Genesee Alternative

Delridge Way SW to Avalon Way SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the north side of SW Genesee Street, near SW Avalon Way, and along the south side of SW Genesee Street, near Delridge Way SW.

Alternative 6.1 - West Seattle Avalon Subsegment – Center of SW Avalon Way

30th Avenue SW to 36th Avenue SW. Noise modeling indicates that Alternative 6.1 of the Green Line alternative alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.1.3 - West Seattle Avalon Subsegment – North Side of Fauntleroy Way SW

36th Avenue SW to 40th Avenue SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the north side of Fauntleroy Way SW, between 38th Avenue SW and 37th Avenue SW. No other noise impacts are expected along this subsegment of Alternative 6.1.3 of the Green Line alignment.

Alternative 6.1.4 - West Seattle Avalon Subsegment – South Side of Fauntleroy Way SW

36th Avenue SW to 40th Avenue SW. Noise modeling indicates that Alternative 6.1.4 of the Green Line alignment would not cause impacts at any receivers in this subsection of this subsegment.

Table 4.7-14c. Impact Analysis Results - West Seattle Segment – Avalon Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.1.3		Alternative 6.1.4		Alternative 6.2		Alternative 6.2.1		Alternative 6.2.2 – Preferred	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
30 th Avenue SW to 40 th Avenue SW 35 mph	6	70	60	No Impact					60	No Impact				
	7	65	53	No Impact					53	No Impact				
	8	70			57	No Impact	54	No Impact						
	9	67			61	No Impact	57	No Impact						
	10	70			65	Potentially Significant	59	No Impact						
	15	70	59	No Impact					59	No Impact				
	16	67 ^a									64 ^a	No Impact	57 ^a	No Impact
	17	61									57	No Impact	59	Moderate
	18	67									58	No Impact	57	No Impact
	19	72 ^a			57 ^a	No Impact	64 ^a	No Impact						

^a Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

Source: Modeling and calculations by MFG, Inc.

Table 4.7-14d. Impact Analysis Results - West Seattle Segment – Alaska Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1 - Preferred		Alternative 6.2	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
40 th Avenue SW to SW Edmunds Street 40 mph	20	49			51	No Impact
	21	49			55	Moderate
	23	61	50	No Impact		

Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

Source: Modeling and calculations by MFG, Inc.

Alternative 6.2 - West Seattle Avalon Subsegment – Center of SW Avalon Way

30th Avenue SW to 35th Avenue SW. Noise modeling indicates that Alternative 6.2 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2.1 - West Seattle Avalon Subsegment – East Side of 35th Avenue SW

SW Avalon Way to 40th Avenue SW. Noise modeling indicates that Alternative 6.2.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2.2 - West Seattle Avalon Subsegment – Center of 35th Avenue SW – Preferred Alternative

SW Avalon Way to 40th Avenue SW. Noise modeling indicates that moderate noise impacts could occur at first-row residential receivers along the west side of 35th Avenue SW, between SW Avalon Way and SW Alaska Street (an apartment building). No other noise impacts are expected along this subsegment of the Green Line alignment.

Alternative 6.1 - West Seattle Alaska Subsegment – 42nd Avenue SW – Preferred Alternative

40th Avenue SW to SW Edmunds Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2 - West Seattle Alaska Subsegment – 44th Avenue SW

40th Avenue SW to SW Edmunds Street. Noise modeling indicates that moderate noise impacts could occur at first-row residential receivers along the east side of 44th Avenue SW, just north of SW Alaska Street. No other noise impacts are expected along this subsegment of the Alternative 6.2 of the Green Line alignment.

Alternative 6.1 - West Seattle California Subsegment – Center of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1 of the Green Line alignment.

Table 4.7-14e. Impact Analysis Results - West Seattle Segment – California Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.1.6		Alternative 6.1.6(s) ^a <i>Preferred</i>		Alternative 6.2	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
SW Edmunds Street to SW Hudson Street 20 mph	22	66	56	No Impact	56	No Impact	54	No Impact	54	No Impact
	24	66	55	No Impact	52	No Impact	50	No Impact	59	No Impact
	25	61	50	No Impact	48	No Impact	44	No Impact	50	No Impact
SW Hudson Street to SW Dawson Street 35 mph	26	66	62	Potentially significant	63	Potentially significant	57	No Impact	60	No Impact
	27	66	62	Potentially significant	58	No Impact	54	No Impact	67	Potentially significant
	28	61	53	No Impact	52	No Impact	47	No Impact	54	No Impact
North of SW Dawson Street to SW Dawson Street 20 mph	28a	66					58	No Impact		
	28b	61					50	No Impact		
SW Dawson Street to SW Raymond Street 50 mph	29	66	68	Potentially significant	68	Potentially significant	67	Potentially significant	66	Potentially significant
	30	63	57	No Impact	56	No Impact	54	No Impact	59	No Impact
	31	66	62	Potentially significant	59	No Impact	58	No Impact	63	Potentially significant
	31a	61					54	No Impact		
	31b	66					63	Potentially Significant		
	31c	66					69	Potentially significant		
	31d	63					57	No Impact		
	32	61	57	No Impact	55	No Impact	52	No Impact	58	No Impact
SW Raymond Street to SW Graham Street 40 mph	33	66	68	Potentially significant	64	Potentially significant	60	No Impact	73	Potentially significant
	34	66	63	Potentially significant	63	Potentially significant	63	Potentially significant	65	Potentially significant
SW Graham Street to south of SW Holly Street 25 mph	35	66	64	Potentially significant	60	No Impact	58	No Impact	81	Potentially significant
	36	66	59	No Impact	59	No Impact	62	Potentially Significant	66	Potentially Significant
	37	68							58	No Impact
	38	66	58	No Impact	55	No Impact	51	No Impact	69	Potentially significant
	39	68	55	No Impact	52	No Impact	47	No Impact	62	No Impact
	40	68							57	No Impact

^a Speed profile and headway information used for 6.1.6(s) were based on more detailed information than any other alternative presented in this table. Comparison of impacts among 6.1.6(s) and other alternatives is therefore not accurate.

Source: Modeling and calculations by MFG, Inc.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. Potentially significant noise impacts could also occur at receivers set back approximately 100 feet from California Avenue SW along the east side of the road within this subsegment. No other noise impacts are expected.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1 of the Green Line alignment.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.1.6 - West Seattle California Subsegment – West Side of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.1.6 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1.6 of the Green Line alignment.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1.6 of the Green Line alignment.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this section of the California subsegment. No other noise impacts are expected.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that Alternative 6.1.6 of the Green Line alignment would not cause impacts at any receivers in this subsection of this segment.

Alternative 6.1.6(s) - West Seattle California Subsegment – Single Beam - West Side of California Avenue SW – Preferred Alternative

SW Edmunds Street to SW Dawson Street. Noise modeling indicates that Alternative 6.1.6(s) of the Green Line alternative alignment would not cause impacts at any receivers in this section of the California subsegment of the Green Line alignment.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s). No other noise impacts are expected.

SW Raymond Street to SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within

this section of the California subsegment of Alternative 6.1.6(s) of the Green Line alignment. No other noise impacts are expected.

Alternative 6.2 - West Seattle California Subsegment – East Side of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.2 of the Green Line alignment would not cause impacts at any receivers in this section of the California subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east side of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. Potentially significant noise impacts could also occur at receivers set back from California Avenue SW along the east side of the road, within this section of this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.2 of the Green Line alignment.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east side of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

Preferred Alternative - West Seattle – Combinations of Subsegments (summary)

Duwamish Subsegment: Alternative 6.1.1(s). Noise modeling was not conducted for this alternative past Pigeon Point. However, based on modeling results of all other alternatives, noise impacts are not expected at any receivers in this subsection of this segment. Similarly, noise impacts are not expected with any other Green Line Alternative in this subsegment.

Delridge Subsegment: Alternative 6.3(s). Noise modeling was not conducted for this alternative in this subsegment. However, because there are no sensitive receivers in the vicinity of this alternative, noise impacts are not expected at any residential, recreational, or commercial locations in this subsegment. The same is true for Alternatives 6.2, 6.4, and 6.4(s). In contrast, alternatives 6.1 and 6.5 (Genesee) through this subsegment would be expected to result in potentially significant noise impacts at residential receivers in this subsegment because both these alignments contain more straight guideway sections where the monorail trains would travel faster near homes in this area.

Avalon Subsegment: Alternative 6.2.2. Noise modeling indicates that moderate noise impacts could occur at the numerous first-row residential receivers along the west side of 35th Avenue SW, between SW Avalon Way and SW Alaska Street (an apartment building). Alternative 6.1.3 would also be expected to cause potentially significant noise impacts at some residential receivers in this subsegment, but at far fewer than the Preferred Alternative because the 6.1.3 alignment is on the north side of Fauntleroy where there are fewer nearby homes. No other Green Line Alternatives through this subsegment would be expected to cause noise impacts because the 6.1.4 alignment along the south side of Fauntleroy passes

near commercial uses, and the 6.2.1 alignment is along the east side of 35th, and is thus farther from residences in this area.

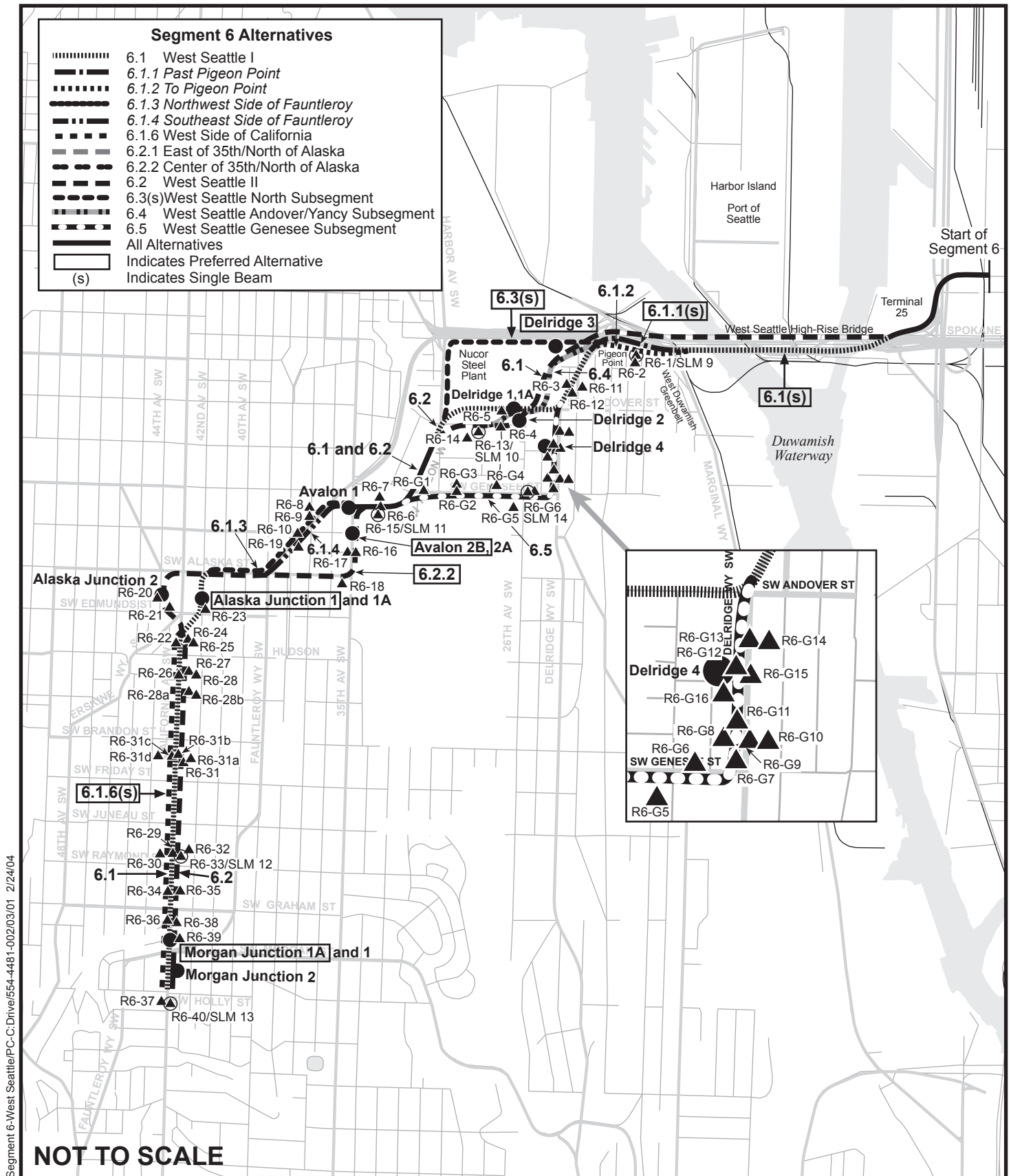
California Subsegment: Alternative 6.1.6(s):

SW Edmunds Street to SW Dawson Street. Noise modeling indicates that Alternative 6.1.6(s) of the Green Line alignment would not cause impacts at any receivers in this section of the California subsegment of the Green Line alternative alignment. Although a direct comparison of this alternative with other alternatives is not strictly possible due to refinements in modeling assumptions (i.e., speed and headway), a close comparison would likely find that no impacts would occur in this area with Alternative 6.1.6 using a more refined speed profile. This contrasts with the findings of the Draft EIS modeling assessment that indicated potentially significant impacts in this area. On the other hand, Alternatives 6.1 and 6.2 would likely cause potentially significant impacts at first-row receivers along the east side of California Avenue SW, north of SW Dawson Street because these alignments in the center and east side of road, respectively, would be closer to residences east of the road. The trains would be traveling at about 40 mph near SW Dawson Street.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s). Applying the same, more refined speed profile used for Alternative 6.1.6(s) to Alternative 6.1.6 would likely result in the same number of projected noise impacts because of the similarity of these alignments. In contrast, Alternatives 6.1 and 6.2 would likely cause additional noise impacts at first row receivers along the east side of California Avenue SW in this area, and potentially at receivers set back from the roadway because these alternatives are closer to the east side of the road.

SW Raymond Street to SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s) of the Green Line alignment. Alternative 6.1.6 would likely be projected to cause identical noise impacts in this area if the same speed profile were used because of the similarity of these alignments. Similarly, applying the more refined speed profile, Alternatives 6.1 and 6.2 would likely be projected to cause noise impacts at several first-row receivers east of California Avenue just south of SW Graham Street both because of high travel speeds and because the 6.1 and 6.2 alignments would be closer to residences east of the road.

Table 4.7-15 provides an estimate of the numbers of residential units that could be potentially affected by noise related to the proposed Green Line project. Those portions of the various alternatives that comprise the Preferred Alternative are labeled and highlighted.



Segment 6-West Seattle/PC-C:Drive/554-4481-002/03/01 2/24/04



R6-15/SLM 10 (triangle) Receptor and SLM
R6-16 (triangle) Receptor

Figure 4.7-9
Segment 6: West Seattle
SLM and Model Receptor Locations

Table 4.7-15. Numbers of Potentially Impacted Residences by Project Segment and Alternative

Location within Segment	Subsegment Alternative	Notes on Impacts	Impact Type	Approximate # of Impacted Residences
Ballard				
Entire Segment	1.1	First row west of road	Potentially Significant	110
		Second row west of road - with partial shielding from 15 th	Moderate	80
		Second row east of, and within 140' of road	Moderate	20
	1.1(s) Preferred	First row west of road	Potentially Significant	29
		Second row west of road	Moderate	24
	1.2	Second row east of, and within 140' of road	Moderate	20
Interbay/Magnolia				
Entire Segment	All Alternatives	No impacts predicted through this segment	No Impacts	0
Queen Anne/ Seattle Center/ Belltown				
West Harrison Street to Seattle Center	3.1 - Preferred	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	8
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
	3.2	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	16
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
	3.3 and 3.5 same as 3.1 in this subsegment	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	8
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
Seattle Center to Virginia Street	All alternatives	No impacts predicted through this subsegment	No Impacts	0
Downtown/Pioneer Square				
Entire Segment	4.1 - Preferred 4.1.1 & 4.1.2	Pike Street to Marion Street First row west of Second Avenue	Potentially Significant	30
	4.2	Pine Street to Pike Street First row east of Second Avenue	Potentially Significant	12
	4.3	No impacts predicted through this segment	No Impacts	0
	4.4	Pine Street to Pike Street First row east of Second Avenue	Potentially Significant	12
SODO/Chinatown International District/Pioneer Square				
Entire Segment	All Alternatives	No impacts predicted through this segment	No impacts	0

**Table 4.7-15. Numbers of Potentially Impacted Residences by Project Segment and Alternative
(continued)**

Location within Segment	Subsegment Alternative	Notes on Impacts	Impact Type	Approximate # of Impacted Residences
West Seattle				
Duwamish Crossing	All Alternatives Incl. Preferred	No impacts predicted through this subsegment	No Impacts	0
Delridge	6.1	Yancy Street area first row receivers	Potentially Significant	15
	6.2, 6.3(s) – Preferred, 6.4, 6.4(s)	No impacts predicted through this subsegment	No Impacts	0
	6.5	SW Avalon to Delridge Way SW First row north and south of SW Genesee	Potentially Significant	31
Avalon	6.1	No impacts predicted through this subsegment	No Impacts	0
	6.1.3	Fauntleroy Way SW First row receiver north of Fauntleroy	Potentially Significant	2
	6.1.4, 6.2, 6.2.1	No impacts predicted through this subsegment	No Impacts	0
	6.2.2 - Preferred	35 th Avenue SW First row west of 35 th Avenue SW	Moderate	63
Alaska	6.1	No impacts predicted through this subsegment	No Impacts	0
	6.2	First row east of 44 th Avenue SW	Moderate	12
California	6.1	SW Edmunds to Holly first- and second-row receivers	Potentially Significant	298
	6.1.6	Hudson to Graham First row receivers	Potentially Significant	234
	6.1.6(s) - Preferred	Edmunds to Holly First row receivers West side of California	Potentially Significant	83
		Edmunds to Holly First row receivers East side of California	Potentially Significant	33
	6.2	Hudson to Holly First row receivers	Potentially Significant	296
Estimated Total Numbers of Impacted Residences with Green Line Preferred Alternative				
<i>Green Line Preferred Alternative Alignment</i>			Moderate	87
			Potentially Significant	201

^a Speed profile and headway information used for all portions of the Preferred Alternative were based on more detailed information than were applied in the previous modeling. Comparisons of impacts among the Preferred Alternative and the other alternatives alignments are therefore not accurate.

Source: Modeling and calculations by MFG, Inc.

4.7.2.3 Vibration Impact Assessment from Green Line Operations

Segment 1: Ballard Segment

Potentially sensitive land uses along the Ballard Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec), with no High Sensitivity or Special Buildings along either alignment Alternative 1.1 or 1.2. This section focuses the vibration impact analysis discussion on land use types that are sensitive to vibration as described above in Section 4.7.1.4. Refer to Section 4.3, Land Use and Neighborhoods, for a more complete description of land use impacts to all land use types.

Alternative 1.1 - West Side of 15th

The distance from the centerline of the Green Line alignment Alternative 1.1 to the closest residential receiver property is 12 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB re 1 micro inch/sec limit for this land use.

The closest Historic Building is B-114, Historic Apartment Building, 1505 NW 60th Street, located 25 feet from the alignment Alternative 1.1. Corresponding vibration levels at the Apartment Building from Green Line operations are below 61.4 VdB re 1 micro inch/sec. Therefore, the predicted future vibration levels are below the 72 VdB re 1 micro inch/sec limit for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

Support columns for the Green Line west bridge Alternative 1.1.1 and far west bridge Alternative 1.1.2 could be placed next to existing offices, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75.0 VdB re 1 micro inch/sec limit for Institutional land uses.

Alternative 1.2 - Center of 15th Avenue

The distance from the centerline of the Green Line alignment Alternative 1.2 to the closest residential receiver property is 50 feet, corresponding to a vibration level of 53.4 VdB re 1 micro inch/sec at the property line. The predicted future vibration levels are below the limits for residential land uses.

Building B-114, Historic Apartment Building, 1505 NW 60th Street, is located 50 feet from alignment Alternative 1.2. Corresponding vibration levels at the Apartment Building from monorail operation are 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

Support columns for the Green Line east bridge Alternative 1.2 could be placed next to existing commercial buildings, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75.0 VdB re 1 micro inch/sec limit for Institutional land use.

The closest Historic Building is B-131, Mike's Chili Parlor, 1447 NW Ballard Way, located 25 feet from alignment Alternative 1.2. Corresponding vibration levels at Mike's Chili Parlor from Green Line operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB re 1 micro inch/sec threshold for this land use and well below the 95 VdB re 1 micro inch/sec threshold for architectural damages to extremely fragile historic buildings.

Ballard Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternative 1.1 or 1.2. Due to the longer average distance between the Green Line columns and adjacent property, Alternative 1.2 would generate lower overall vibration levels than Alternative 1.1.

The Preferred Alternative for the Ballard Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold, similar to Alternative 1.1.

Segment 2: Interbay Segment

Potentially sensitive land uses along the Interbay Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec), with three High Sensitivity land uses (vibration impact limit 65 VdB re 1 micro inch/sec) along either alignment Alternative 2.1 or 2.2:

- Friedman & Bruya, Inc., Environmental Chemists, at 3012 16th Avenue W.
- Amgen Campus at 1555 W Galer Street.
- Cell Therapeutics, Inc. at 501 Elliott Avenue West Building.

Alternative 2.1 - West Side of 15th/Center of Elliott

The minimum distance from the centerline of Alternative 2.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72.0 VdB limit for Residential and 75.0 VdB limit for Institutional land uses.

Between the Dravus 1 (16th) station alternative and the alignment transition to the west side of 15th Avenue W, the Green Line alignment passes through some residential land uses. Support columns could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating Green Line columns at least 10 feet away from residential land use would reduce vibration levels below the 72 VdB threshold.

The Friedman & Bruya, Inc. site located at 3012 16th Avenue W is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.1 is located over the northeast corner of the property approximately 20 feet from the building. This would result in vibration levels of 61.4 VdB re 1 micro inch/sec, which is below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The Amgen Campus located at 1555 W Galer Street (Pier 88) is also a High Sensitivity land use. The Green Line alignment Alternative 2.1 along the center of Elliott Avenue W is more than 250 feet away from the closest building structure, with vibration levels below 45 VdB re 1 micro inch/sec. This is substantially lower than the 65 VdB threshold for this type of use.

The Cell Therapeutics, Inc. site located at 501 Elliott Avenue West Building is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.1 along the center of Elliott Avenue W is more than 40 feet from the building. This would result in vibration levels of 55.4 VdB re 1 micro inch/sec, which is substantially below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The closest Historic Building is I-74, Ace Tank, 1123c Elliott Avenue W, located 50 feet from alignment Alternative 2.1. Corresponding vibration levels at Ace Tank from Green Line operations are 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 2.1.1 - West Bridge Connection

Support columns for alignment Alternative 2.1.1 could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for Institutional land uses.

Alternative 2.1.2 - Far West Bridge Connection

Support columns for alignment Alternative 2.1.2 could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for Institutional land uses.

Alternative 2.2 - Center of 15th/West Side of Elliott

The predicted future vibration levels are below the limits for Residential (72 VdB re 1 micro inch/sec) and Institutional land uses (75 VdB re 1 micro inch/sec). The minimum distance from the centerline of alignment Alternative 2.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line.

The east bridge connection associated with Alternative 2.2 is more than 100 feet away from the closest residential land use, corresponding to a vibration level of 46.4 VdB re 1 micro inch/sec. This is well below the maximum vibration level of 72 VdB re 1 micro inch/sec for residential land use.

Between the Dravus 2 (15th) station alternative and the alignment transition to the center of 15th Avenue W, the distance to the closest structure is 50 feet, corresponding to a vibration level of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for Residential (72 VdB) and Institutional (75 VdB) land uses.

The Friedman & Bruya, Inc. site located at 3012 16th Avenue W is a High Sensitivity land use. The Green Line alignment Alternative 2.2 is approximately 100 feet away from the building, corresponding to a vibration level of 46.4 VdB re 1 micro inch/sec. This is well below the maximum vibration level of 65 VdB re 1 micro inch/sec for this sensitive receiver.

The Amgen Campus located at 1555 W Galer Street (Pier 88) is also a High Sensitivity land use. The Green Line alignment Alternative 2.2 along the west side of Elliott Avenue W is more than 200 feet away from the closest building structure, with vibration levels well below 45 VdB re 1 micro inch/sec. This is substantially lower than the 65 VdB threshold for this land use type.

The Cell Therapeutics, Inc. site located at 501 Elliott Avenue West Building is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.2 along the west side of Elliott Avenue W is approximately 20 feet from the building. This would result in vibration levels of 61.4 VdB re 1 micro inch/sec, which is below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The closest Historic Building is I-74, Ace Tank, 1123c Elliott Avenue W, located 25 feet from alignment Alternative 2.2. Corresponding vibration levels at Ace Tank from Green Line operations are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this

land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Interbay Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration thresholds, no vibration impacts would be expected with Alternative 2.1 or 2.2. Due to the longer average distance between Green Line columns and adjacent properties (including the Friedman & Bruya, Inc. sensitive receiver), Alternative 2.2 has a lower overall vibration impact than Alternative 2.1.

The Preferred Alternative for the Interbay Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Potentially sensitive land uses along the Queen Anne/Seattle Center/Belltown Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with three Special Buildings (vibration impact limit 65 VdB re 1 micro inch/sec for Concert Halls, and 72 VdB re 1 micro inch/sec for Theaters), and one High Sensitivity land use (vibration impact limit 65 VdB re 1 micro inch/sec) along Green Line alignment Alternatives 3.1, 3.2, 3.3, or 3.5.

- Pacific Biometrics, Inc. at 220 West Harrison Street.

Alternative 3.1 - Seattle Center/Republican

The minimum distance from the centerline Green Line alignment Alternative 3.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the limits for Residential (72 VdB) and Institutional (75 VdB) land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.1 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to 59.8 VdB, well below the threshold of 72 VdB.

The Pacific Biometrics, Inc. site located at 220 West Harrison Street is a High Sensitivity land use for vibration. The Green Line alignment Alternative 3.1 along the south side of Harrison is more than 40 feet from the building. This would result in vibration levels of 55.4 VdB re 1 micro inch/sec, which is substantially below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

Between Broad Street and Fifth Avenue, alignment Alternative 3.1 would be adjacent to structures with institutional land uses. With the predicted vibration levels at the base of the support columns being 74.0 VdB re 1 micro inch/sec, vibration levels are below the limits for institutional land uses.

The Bagley Wright Theater and Intiman Theater are both located 140 feet from alignment Alternative 3.1, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration levels for theaters. Therefore, no vibration impacts to the Bagley Wright Theater and Intiman Theater are expected.

The Marion Oliver McCaw Hall is located more than 250 feet away from alignment Alternative 3.1, corresponding to vibration levels below 45.0 VdB re 1 micro inch/sec. The predicted future vibration

levels are well below the maximum 72 VdB vibration levels for concert halls. Therefore, no vibration impact to the Marion Oliver McCaw Hall is expected.

The closest Historic Building is SC-15, Center House at Seattle Center, located 15 feet from alignment Alternative 3.1. Corresponding vibration levels at the Historic Building from monorail operation are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for this land use and well below the 95 VdB limit for architectural damages to extremely fragile historic buildings.

Alternative 3.1.1 - Through EMP

With the Green Line going through the EMP, the vibration levels at the outer edge of the building approximately 10 feet away from the base of the columns are predicted to be 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB limit for theaters. Therefore, no vibration impact to the EMP is expected.

No increase of the vibration levels inside the EMP would be expected since the existing monorail currently goes through EMP on a similar alignment. With the new Green Line train and guideway design, the vibration impact to the EMP would be lower than current levels.

Alternative 3.1.2 - Around EMP

The minimum distance from the centerline of Green Line alignment Alternative 3.1.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for theaters.

Alternative 3.2 - Mercer

The minimum distance from the centerline of Green Line alignment Alternative 3.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.2 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to 59.8 VdB, well below the 72 VdB threshold.

The Pacific Biometrics, Inc. site located at 220 West Harrison Street is a High Sensitivity land use for vibration. The Green Line alignment Alternative 3.2 along the north side of Harrison is approximately 10 feet from the building. This would result in vibration levels of 65.4 VdB re 1 micro inch/sec, which is marginally above the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver. It is recommended to space the support columns a minimum of 20 feet from the face of the building which would reduce the overall vibration levels to 61.4 VdB re 1 micro inch/sec below the maximum allowable vibration levels for sensitive receivers.

The Bagley Wright Theater is located 30 feet from alignment Alternative 3.2, corresponding to vibration levels below 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Bagley Wright Theater is expected.

The Intiman Theater is located 60 feet from alignment Alternative 3.2, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Intiman Theater is expected.

The Marion Oliver McCaw Hall is located more than 60 feet from alignment Alternative 3.2, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for concert halls. Therefore, no vibration impact to the Marion Oliver McCaw Hall is expected.

The closest Historic Building is SC-20, Auditorium Apartments, 605 Fifth Avenue N, located 20 feet from the alignment Alternative 3.2. Corresponding vibration levels at the Historic Building from monorail operation are 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 3.3 - Thomas

The minimum distance from the centerline of the Green Line alignment Alternative 3.3 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.3 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to below the 72.0 VdB threshold for this use.

Pacific Biometrics, Inc. site, same as Alternative 3.1.

No vibration impact to Bagley Wright Theater, Intiman Theater, or Marion Oliver McCaw Hall would be expected with alignment Alternative 3.3.

The closest Historic Building is SC-7, 7 Queen Anne Avenue N, located 25 feet from the alignment Alternative 3.3. Corresponding vibration levels at the Historic Building from monorail operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 3.5 - Second/Denny

The minimum distance from the centerline of the Green Line alignment Alternative 3.5 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.5 is located adjacent to residential uses, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to below the 72.0 VdB threshold for this use.

Pacific Biometrics, Inc. site, same as Alternative 3.1.

The Seattle Children's Theater is located 50 feet from alignment Alternative 3.5, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Seattle Children's Theater is expected.

Fisher Pavilion is located 50 feet from alignment Alternative 3.5, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 65 VdB threshold for recording studios. Therefore, no vibration impact to Fisher Pavilion is expected.

No vibration impact to Bagley Wright Theater, Intiman Theater, or Marion Oliver McCaw Hall would be expected with Alternative 3.5.

The closest Historic Building is SC-7, 7 Queen Anne Avenue N, located 25 feet from alignment Alternative 3.5. Corresponding vibration levels at the Historic Building from monorail operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Queen Anne/Seattle Center/Belltown Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration thresholds, no vibration impacts would be expected with Alternatives 3.1, 3.2, 3.3, or 3.5. Due to the longer distance between Green Line columns and sensitive receivers in this segment, Alternatives 3.3 and 3.5 would generate the lowest vibration levels of all alternatives. The highest overall vibration level would occur with Alternative 3.2 due to its close proximity to Pacific Biometrics Inc. and Seattle Center theaters, although this alternative would not result in vibration impacts as long as columns are located a minimum of 20 feet from the building.

The Preferred Alternative for the Queen Anne/Seattle Center/Belltown Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold, similar to Alternative 3.1.

Segment 4: Downtown Segment

Potentially sensitive land uses along the Downtown Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with three Special Buildings (vibration impact limit 65 VdB re 1 micro inch/sec for Concert Halls) along Green Line alignment Alternatives 4.1, 4.2, and 4.3.

Alternative 4.1 - West Side of Second

Along Second Avenue, alignment Alternative 4.1 would be adjacent to existing structures where residential land uses exist. The minimum distance from the centerline of Alternative 4.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold Institutional land uses. There is no difference in impacts for alignment Options 4.1.1 and 4.1.2.

Benaroya Hall is located 60 feet from alignment Alternative 4.1, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 65 VdB vibration levels for concert halls. Therefore, no vibration impact to Benaroya Hall is expected.

The Moore Theater is located 100 feet from alignment Alternative 4.1, corresponding to vibration levels of 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 20 feet from the alignment Alternative 4.1, corresponding to vibration levels of 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-34, Times Square Building, 414 Olive Way, located 15 feet from alignment Alternative 4.1. Corresponding vibration levels at this Historic Building from Green Line operations are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of the alignment Alternative 4.1. Corresponding vibration levels at the Areaways from Green Line operations are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 4.2 - East Side of Second with Crossover

The minimum distance from the centerline of alignment Alternative 4.2 to the closest receiver property is 15 feet, corresponding to vibration levels of 63.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

Benaroya Hall is located 15 feet from alignment Alternative 4.2, corresponding to a vibration level of 63.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 65 VdB vibration threshold for concert halls. Therefore, no vibration impact to Benaroya Hall is expected.

The Moore Theater is located more than 100 feet from alignment Alternative 4.2, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 65 VdB vibration threshold for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 50 feet from alignment Alternative 4.2, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB maximum vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-34, Times Square Building, 414 Olive Way, located 15 feet from the alignment Alternative 4.2. Corresponding vibration levels at this Historic Building from Green Line operations are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of alignment Alternative 4.2. Corresponding vibration levels at the Areaways from Green Line operations are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 4.3 - Center of Second

The minimum distance from the centerline of alignment Alternative 4.3 to the closest receiver property is 40 feet, corresponding to vibration levels of 55.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

Benaroya Hall is located 40 feet from alignment Alternative 4.3, corresponding to a vibration level of 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 65 VdB threshold for concert halls.

The Moore Theater is located more than 100 feet from alignment Alternative 4.3, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration levels for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 30 feet from alignment Alternative 4.2, corresponding to vibration levels of 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-126, King Street Station, 301 S Jackson Street, located 30 feet from alignment Alternative 4.3. Corresponding vibration levels at the Historic Building from monorail operation are 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of alignment Alternative 4.3. Corresponding vibration levels at the Areaways from monorail operation are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 4.4 – East Center of Second

The minimum distance from the Centerline of alignment Alternative 4.4 to the closest receiver property is approximately 25 feet corresponding to vibration levels of 59.9 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 65 VdB threshold for special buildings such as concert halls and theaters.

Downtown Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 4.1, 4.2, 4.3 or 4.4. The Preferred Alternative for the Downtown Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 5: SODO Segment

Potentially sensitive land uses along the SODO Segment are mostly Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with some Residential (vibration impact limit 72 VdB re 1 micro inch/sec). The Pioneer Square Historic District, including King Street Station, is located at the north end of this segment.

Alternative 5.1 - East Side of Third/Utah

The minimum distance from the centerline of alignment Alternative 5.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the limits for Residential and Institutional land uses. There is no difference in vibration impact for alignment Options 5.1.1 and 5.1.2.

The closest Historic Building is S-58, Markey Machinery Co., 79 S Horton Street, located 40 feet from alignment Alternative 5.1. Corresponding vibration levels at the Historic Building from Green Line operations are 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 5.2 - West Side of Third/Utah

The minimum distance from the centerline of alignment Alternative 5.2 to the closest receiver property is 40 feet, corresponding to vibration levels of 55.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

The closest Historic Building is S-61, Rainier Cold Storage Building, on the southeast corner of S Horton Street and Colorado Avenue S, located 40 feet from alignment Alternative 5.2. Corresponding vibration levels at the Historic Building from Green Line operations are 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

SODO Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 5.1 and 5.2. The Preferred Alternative for the SODO Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 6: West Seattle Segment

Land uses along the West Seattle Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with no High Sensitivity or Special Buildings along the alignments.

Alternative 6.1 - West Seattle I

The minimum distance from the centerline of alignment Alternative 6.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 72 VdB threshold for Institutional land uses.

The Arts West Theater is located more than 200 feet from the Alternative Alignment 6.1, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Arts West Theater is expected.

Along California Avenue SW, the minimum distance from the centerline of alignment Alternative 6.1 to the closest receiver property is 30 feet, corresponding to vibration levels of 58.4 VdB re 1 micro inch/sec

at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential and 75 VdB threshold for institutional land uses.

The closest Historic Building is WS-154, Residence, 5956-5958 California Avenue SW, located 40 feet from alignment Alternative 6.1. The corresponding vibration level at this Historic Building from Green Line operations is 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 6.2 – West Seattle II

The minimum distance from the centerline of alignment Alternative 6.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold Institutional land uses.

The Arts West Theater is located 50 feet from alignment Alternative 6.2, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Arts West Theater is expected.

Along California Avenue SW, the minimum distance from the centerline of Alternative 6.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

The closest Historic Building is WS-154, Residence, 5956-5958 California Avenue SW, located 20 feet from alignment Alternative 6.2. The corresponding vibration levels at this Historic Building from Green Line operations are 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 6.3(s) – Delridge North Subsegment – Preferred Alternative

The minimum distance for the Centerline of alignment Alternative 6.3(s) to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

Alternative 6.4 – West Seattle Andover/Yancy Subsegment

The minimum distance for the Centerline of alignment Alternative 6.4 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

Alternative 6.5 – Genesee Subsegment

The minimum distance for the Centerline of alignment Alternative 6.5 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

West Seattle Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 6.1, 6.2, 6.3(s), 6.4, or 6.5. The increased distance along California Avenue SW from the centerline of alignment Alternative 6.1 to the closest building structures results in a lower overall impact of this alignment compared with Alternative 6.2 or 6.1.6. All of the alignment options in the West Seattle Segment (6.1.1, 6.1.2, 6.1.3, and 6.1.4) would result in similar vibration impacts.

With the single beam alignment alternatives, the vibration levels from operation will be lower than the dual beam configuration. The decrease of the vibration amplitude from two trains at maximum speed crossing at an expansion gap to one train is 6 VdB re 1 micro inch/sec. Therefore, the already low operational vibration levels would be even lower with this single beam configuration exists.

Switches north and south of the stations transitioning from a single to a dual beam configuration are necessary for operation. Both “Beam Replacement Switches” and “Segmented Pivot Type Switches” will move beam sections between the two main beams before and after the stations. The switches are moving the beam sections at a very low speed, for instance the Walt Disney World monorail beam replacement switches cycle in twelve seconds, reducing the dynamic switching forces to well below of the operational. (“The Switch Myth” by Kim Pedersen <http://www.monorails.org/tMspages/switch.html>).

Assuming the trains are not going faster than 15 mph entering and leaving a station, the vibration levels due to the reduced speed are calculated to be 10 VdB re 1 micro inch/sec lower than one train at 50 mph, see Chapter 10: General Vibration Assessment, Page 7 – FTA Final Report 1995. This would bring the overall vibration levels from the original two beam, two train model down a total of 16 VdB re 1 micro inch/sec.

Summary:

All areas evaluated for single beam configuration will generate equal or lower vibration levels than the original alignments evaluated in Section 4.7.2.3. The single beam segments limit the traffic to one train at a time and therefore also reduce the vibration impact levels resulting from two trains passing at the same time.

All Station Alternatives

At all stations, vibration levels at the base of the support columns would be below the maximum vibration levels for High Sensitivity land uses (65 VdB re 1 micro inch/sec) due to the reduced train speed approaching and leaving the station. Therefore, no vibration impacts from Green Line operations are expected at stations.

Ground-borne vibration levels vary at approximately 20 times the logarithm of the speed of the train. This means that doubling the train speed would increase the vibration levels approximately 6 VdB re 1 micro inch/sec and halving the speed would reduce the level by 6 VdB re 1 micro inch/sec. Table 4.7-16 shows the predicted vibration levels at stations under a variety of operating conditions.

4.7.2.4 Noise and Vibration Impacts from Construction

Construction of the Green Line would generate various noise and vibration impacts depending on the type of equipment used, distance to closest receivers, and soil conditions. Refer to Section 4.17, Construction, for the construction noise and vibration impact analysis and mitigation measures.

Table 4.7-16. Predicted Vibration Levels at Stations

Description	Vibration Level
Two trains at 25 mph in opposite direction with maximum braking	73.8 VdB
Two trains at 25 mph in opposite direction with maximum acceleration	73.9 VdB
At column base two trains at 25 mph in opposite direction with maximum braking	63.8 VdB
At column base two trains at 25 mph in opposite direction with maximum acceleration	63.9 VdB
At column base two trains at 10 mph in opposite direction with maximum braking	55.8 VdB
At column base two trains at 10 mph in opposite direction with maximum acceleration	55.9 VdB
At column base two trains at 5 mph in opposite direction with maximum braking	49.8 VdB
At column base two trains at 5 mph in opposite direction with maximum acceleration	49.9 VdB

RMS velocity Levels, VdB re 1 micro inch/sec.

4.7.2.5 No Action Alternative Impacts

The No Action Alternative would not create noise or vibration impacts to any buildings adjacent to the Green Line corridor.

4.7.3 Mitigation

4.7.3.1 Noise Mitigation

Because the noise analysis identified potential impacts associated with Green Line alternatives, it is necessary to consider mitigation measures to reduce or eliminate such impacts. The following section considers potential mitigation measures that could be implemented to reduce noise impacts related to operation of the Green Line. For discussion of the mitigation measures related to potential impacts related to construction noise, refer to Section 4.17, Construction.

Based on the modeling assessment conducted for this evaluation, it was preliminarily determined that sound levels from Green Line trains could need to be reduced from 3 to 14 dBA to avoid impacts at all residential use locations along the alternative alignments. There appear to be a number of potential methods of reducing noise transmission from the trains. These could include one or more of the following measures:

- Creating design specifications for train cars that limit their noise levels by incorporating shielding of noise-producing areas or absorptive materials, or by other means.
- Creating design specifications for guideways and stations that enable them to block noise from Green Line trains by incorporating blocking or absorptive materials or by other means.
- Reducing travel speeds in sensitive areas. The noise impact evaluation conducted for the Preferred Alternative presented in the Final EIS used refined assumptions about speed and headways, which reduced projections of noise impacts. Further reductions in speed are unlikely.
- Providing insulating or absorptive materials or other means of shielding to dampen sound penetration to nearby properties.

This EIS presents a reasonable maximum impact scenario for noise based upon extensive analysis and modeling. After the start of operations, noise monitoring will confirm the actual noise levels at sensitive receptors and the effectiveness of mitigation measures and allow for verifiable adjustments. Actual noise impacts could be well below predicted levels.

Table 4.7-17 presents findings of some of the initial considerations of possible noise mitigation measures for the Green Line. Based on this review, it appears highly likely that effective noise mitigation measures could be developed and implemented once the alignment of the Green Line has been decided.

Table 4.7-17. Potential Noise Control Mitigation Measures

Method	Possible Effects	Comments
Travel speed reductions over entire day in impact areas	Direct reduction of noise associated with tire noise on the guideway. Preliminary examination indicates reductions of about 2.3 dBA for each 5 mph reduction. Reducing speed at all times by 5 mph would reduce Ldn by about 2.3 dBA.	Would affect performance of system. Would provide sufficient reduction to avoid impacts in some areas.
Travel speed reductions during some noise-sensitive nighttime hours	Reducing speed 10 mph during hours of 2200-2400 and 0500-0600 reduces Ldn about 1.4 dBA	Would not affect peak use hours, but would not have much effect on daylong sound levels. Would provide sufficient reduction to avoid impacts in a few areas.
Travel speed reductions during all noise-sensitive nighttime hours	Reducing speed 10 mph during hours of 2200-2400 and 0500-0700 reduces Ldn about 2.7 dBA	Would affect one peak use hour, but would have somewhat greater effect on daylong sound levels. Would provide sufficient reduction to avoid impacts in some areas. The evaluation of the Preferred Alternative in the Final EIS used a refined speed profile and modified headway assumptions, which reduced impacts; further speed reductions are unlikely
Travel speed reductions (5 mph) over entire day in impact areas AND 5 mph reductions during some or all noise-sensitive nighttime hours	Reducing the speed 5 mph over the entire day and also reducing the speed an additional 5 mph during 3 nighttime hours reduces the Ldn by 3.1 dBA [-3.8 dBA with all four nighttime hours]	Would provide sufficient reduction to avoid impacts in some areas. Most effective scenario affects one peak use hour.
Travel speed reductions (5 mph) over entire day in impact areas AND 10 mph reductions during some or all noise-sensitive nighttime hours	Reducing the speed 5 mph over the entire day and also reducing the speed an additional 10 mph during 3 nighttime hours reduces the Ldn by 3.7 dBA [-5.0 dBA with all four nighttime hours]	Would provide sufficient reduction to avoid impacts in many areas. Most effective scenario affects one peak use hour.
Using quietest available onboard equipment and treating the equipment and/or the equipment compartments to control noise	Could provide substantial reductions in uncontrolled levels of equipment-related sound levels. This type of control is very feasible.	Most effect in noise reductions for trains moving at slower speeds and at stations.
Adding mass and/or additional skirting to reduce transmission of tire noise	This sort of control is largely undocumented.	Significant control of tire noise may be possible, but raises the issue of additional weight.
Guideway noise barriers	Could provide substantial reductions if strategically placed.	Could be unsightly and would add weight to the guideway.
Noise control measures to reduce interior sound levels in sensitive uses that would otherwise be affected	Could substantially reduce interior levels; has no effect on exterior levels.	Retrofits require custom applications, are labor intensive, and can be expensive.
Combination of the above	Could provide substantial noise reductions.	Requires more complete analysis based on the actual design of the Green Line and development of information regarding the guideway horizontal and vertical alignments and the physical geometry of nearby land and buildings.

Source: MFG, Inc. and Lea & Elliott

4.7.3.2 Vibration Mitigation

The purpose of vibration mitigation is to minimize adverse effects that ground-borne vibration could have to adjacent properties. This section describes mitigation measures that could be implemented for vibration impacts.

For all Green Line alignment alternatives, a minimum 10-foot separation from support columns to any residential land use would reduce the vibration level to 65.4 VdB re 1 micro inch/sec, below the residential vibration threshold of 72 VdB. Since columns are expected to be located at least 10 feet away from residential land uses for any of the Green Line alternatives, no additional mitigation would be required.

For high sensitivity land uses such as Friedman & Bruya, Inc. at 3012 16th Avenue W in the Interbay Segment and Pacific Biometrics, Inc. at 220 W Harrison Street in the Queen Anne segment, a 20-foot separation from the closest support column to the existing building would result in a vibration level of 61.4 VdB re 1 micro inch/sec. This is lower than the 65 VdB re 1 micro inch/sec maximum vibration level for these sensitive receivers. Therefore, no additional mitigation would be required since columns for Alternatives 2.1 and 3.1 would be located at least 20 feet from the building.

In addition, an effective maintenance program should be implemented for controlling ground-borne vibration. This should include standard vehicle maintenance checks on the vehicle tires, tire pressure, and suspension system. A regular check of the guideway surfaces should also be part of the structural maintenance program to maintain a smooth concrete surface for Green Line trains to ride on.

4.7.4 Significant Unavoidable Adverse Impacts

Without effective implementation of mitigation measures, operational noise from the Green Line could cause significant noise impacts at numerous residences along the proposed route. Potentially significant noise impacts have been identified in the following areas: along 15th Avenue NW in Ballard; along W Harrison Street, and along Fifth Avenue between Bell and Lenora Streets in the Queen Anne/Seattle Center/Belltown Segment; along Second Avenue between Pine and Marion Streets in the Downtown Segment; and in West Seattle along SW Yancy Street, along Genesee Street in the Delridge area, and along California Avenue SW between SW Hudson and SW Holly Streets.

For the Preferred Alternative, potential areas of adverse noise impacts include the following areas: along 15th Avenue NW in Ballard; along W Harrison Street in the Queen Anne/Seattle Center/Belltown Segment; along Second Avenue between Pike and Marion Streets in the Downtown Segment; and in West Seattle along California Avenue SW between SW Dawson and SW Holly Streets.

No significant unavoidable adverse vibration impacts are expected with the construction or operation of the Green Line.

4.8 ENERGY

This section summarizes current transportation-related energy use in the Puget Sound region and quantifies the future operational and construction energy use from the Green Line.

4.8.1 Affected Environment

This analysis focuses on existing transportation-related energy use in the Puget Sound region. For the affected environment, the transportation energy analysis identifies energy consumed by automobiles, trucks, buses, and motorcycles (not including boats, trains, and planes). Table 4.8-1 summarizes the average daily energy consumption for transportation uses in the Puget Sound region (Seattle-Everett and Tacoma urbanized areas) in 2001. Vehicle miles traveled (VMT) was estimated for the Puget Sound region by the Puget Sound Regional Council (PSRC). Vehicle mix and average fuel consumption data were used with multipliers from the Transportation Energy Data Book (U.S. Department of Energy 2002) to estimate daily energy consumption for the region. Average weekday regional VMT used approximately 499.089×10^9 British thermal units (Btu) of energy in 2001. Energy is also consumed to maintain and repair vehicles (oil, tires, and general maintenance and repair) and can also be calculated using VMT and multipliers from the Transportation Energy Data Book. Vehicle maintenance adds 70.694×10^9 Btu to daily regional energy consumption.

Transportation-related energy use within Seattle consists of automobiles, trucks, buses, motorcycles, trains, and ferries. Most vehicles are powered by gasoline and diesel. Nineteen King County Metro trolley bus routes are powered by electricity.

Table 4.8-1. Existing Motor Vehicle Energy Consumption in the Puget Sound Region (2001)

Vehicle Type	Percent of VMT ^a	Daily VMT ^b	Average Fuel Consumption (miles per gallon) ^a	Daily Fuel Consumption (gallons)	Daily Energy Consumption (Btu x 10 ⁹)
Light-duty gas automobiles	47.3	31,176,460	23.61	1,320,477	165.060
Light-duty gas trucks 1	26.9	17,732,111	18.53	956,941	119.618
Light-duty gas trucks 2	11.5	7,577,881	14.21	533,278	66.660
Heavy-duty gas vehicles	4.5	2,974,668	7.87	378,096	47.262
Light-duty diesel automobiles	0.1	84,252	26.41	3,190	0.442
Light-duty diesel trucks	0.2	153,276	19.23	7,971	1.106
Heavy-duty diesel vehicles	9.0	5,906,089	8.35	707,570	98.140
Motorcycles	0.5	320,264	50.00	6,405	0.801
Subtotal	100	65,925,000		3,913,928	499.089
Vehicle maintenance					70.694
Total					569.783

Notes: Btu per gallon of gasoline = 125,000. Btu per gallon of diesel = 138,700.

Light-duty trucks 1 = Trucks up to 6,000 pounds gross vehicle weight.

Light-duty trucks 2 = Trucks from 6,000 to 8,500 pounds gross vehicle weight.

Heavy-duty trucks = Trucks over 8,500 pounds gross vehicle weight.

^a Share of vehicle miles traveled (VMT) by vehicle type and average fuel consumption by vehicle type is from Washington State Department of Ecology (Ecology 2003).

^b VMT was calculated for the Puget Sound Region, which includes the Seattle-Everett and Tacoma urbanized areas (PSRC 2001).

Sources: Ecology (2003); PSRC (2001); U.S. Department of Energy (2002).

4.8.2 Impacts

4.8.2.1 Green Line Alternatives

Direct impacts are characterized by the energy that would be consumed by operation of the Green Line. The energy consumed by the Green Line includes operation of monorail trains, transit stations, equipment rooms, and the Operations Center. Energy for potential guideway heating for snow and ice removal on the guideway surfaces and power/signal rails is also considered, although current plans do not include heating the guideway. The tentative recommendation not to heat the guideway is based on an analysis of monorail operations during inclement weather (Lea+Elliott 2003a). Based on National Weather Data Service 30-year temperature and precipitation averages, the analysis concluded that local weather is not concurrently cold and wet enough to create significant ice formation and necessitate guideway heating. During times when frost or ice is expected to form, operating trains on a normal schedule would be sufficient to keep the guideway clear.

Green Line operational energy use was provided by Lea+Elliott. Lea+Elliott's work explains the results of a preliminary power analysis performed for one of the build alternatives (Lea+Elliott 2003b). The detailed simulation results used to calculate these estimates are provided in an analysis by Lea+Elliott (Lea+Elliott 2003c). In order to determine potential energy usage for the Green Line, an analysis of the individual route and station alternatives is not required because all alternatives, including the Preferred Alternative, would use a similar amount of energy. Total distance traveled, number of stations, grade, and/or curve radii are the main factors in monorail power usage. The alternatives are not different enough with respect to these conditions to have a significant difference in power usage. More favorable power consumption may result if any of the single beam segments are implemented (Harris 2003).

Table 4.8-2 summarizes the projected daily operational energy demand for the Green Line. It is estimated that Green Line operations would use 0.590×10^9 Btu daily if there is no guideway heating and 0.593×10^9 Btu daily with guideway heating. It is estimated that Green Line-related energy consumption would represent approximately 0.1 percent of the existing regional energy use for transportation, a relatively small percentage of the region's transportation energy use.

Table 4.8-2. Green Line Daily Operational Energy Use in Btu

Type of Energy Use	Daily Energy Use ^a
Train propulsion	0.318
Operations Center	0.123
Stations	0.072
Equipment rooms	0.077
Total Green Line system energy use	0.590
Optional guideway heating ^b	0.003
Total Green Line energy use with guideway heating	0.593

^a Values provided in 10^9 Btu.

^b Guideway heating based on 480 hours of heating.

Source: Lea+Elliott (2003b).

Seattle City Light has indicated that the estimated power demand for the Green Line would not have a major impact on energy resources available to Seattle City Light, however upgrading some transmission lines and power substations may be required to deliver electrical power to where it is needed (Davis 2003). For comparison purposes, Seattle City Light provided monthly energy use for other large-load

electricity customers. On a monthly basis, SMP would consume less than one seventh of the energy used by Nucor Steel, a local steel mill (Seattle City Light 2003).

While the Green Line could consume additional electrical energy over the No Action Alternative, it would reduce the energy consumed by motor vehicles for trips made on the Green Line instead of motor vehicles (see Section 4.1.2, Table 4.1-7 Transportation). As people choose to travel on the Green Line, some vehicle trips would be shortened or eliminated. Although not possible to predict with precision, the energy savings from the reduction in vehicle trips would partially or fully offset the power requirements of the Green Line.

Power rails mounted to the guideway beam supply the electricity used to power the vehicles' electric motors (Lea+Elliott 2003b). The types of electric motors and motor controllers are dependent on the selection of the monorail train supplier. These rails would have either 750 volts Direct Current (DC) or 1,500 volts DC depending on the selected train supplier. Ten to 20 traction power substations would be constructed along the Green Line alignment to distribute power throughout the system. The number of substations would depend on whether all substations are built with redundant power supply (10 substations needed) or whether each has only a single source (20 substations needed) (Lea+Elliott 2003b). Upgrades to some power transmission lines may be required; impacts to transmission lines and other utilities are discussed in Section 4.9, Public Services and Utilities.

SMP is coordinating with Seattle City Light to ensure a reliable source of power for the Green Line and to minimize impacts to Seattle City Light facilities and resources. This reliability would be achieved by Seattle City Light providing redundant (dual) feeders. It is anticipated that the traction power substations will be supplied by common feeders from one or two Seattle City Light sources. The number of sources needed will depend on Seattle City Light's infrastructure at the time the power is needed for the Green Line. Each passenger station and the Operations Center will be powered by separate electrical service connections.

To maximize the power consumption efficiency of the monorail trains and ensure good power quality, the monorail system supplier will be required to maintain a minimum average power factor of 0.95 and to comply with Institute of Electrical and Electronics Engineers, Inc. Standard 519-1992. The peak line load Kilo-Volt-Amperes (KVA) for any 15-minute period and the average KVA demand estimated are provided in Table 4.8-3. Peak energy demand would most likely occur when peak operation times (6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m.) coincide with periods of extreme weather. The monorail trains would be heated during periods of cold weather and could potentially be air-conditioned during periods of hot weather. In addition, to prevent ice formation on the guideway (if the guideway is not heated), the system would operate on a normal peak period schedule during cold weather periods.

Table 4.8-3. Green Line Operational Energy Use in KVA

	Average KVA	Peak KVA
Train propulsion	15,000	19,000
Operations Center	750	1,500
Stations (including equipment rooms)	5,225	9,500
Total	20,975	30,000
Guideway power rail heating ^a	3,000	3,000
Total	23,975	33,000

^a KVA values for guideway power rail heating are only applicable when the system is turned on during snow/icing conditions.

The monorail train supplier may reduce these peak and average KVA estimates by utilizing regenerative braking (electrical power generation during train deceleration). This generated power would be available for consumption by other trains in the system. Regenerative power is not expected to pass beyond the Seattle City Light point of connection, although it could with Seattle City Light approval. The monorail system supplier would be required to comply with all applicable Seattle City Light codes and regulations for electrical service connections and regenerative power, and all monorail system electrical switchgear would be coordinated with Seattle City Light.

4.8.2.2 No Action Alternative

The No Action Alternative would not require energy for Green Line operations; however, energy savings would not be realized from reduced vehicle trips.

4.8.3 Mitigation

SMP will work with Seattle City Light to implement SMP's environmental sustainability policies as it designs facilities. Where appropriate, electricity conservation measures and electrical system specifications for supply will be implemented. The Green Line would incorporate relevant City of Seattle and Washington State energy code requirements into design where appropriate (for example, energy-efficient lighting, mechanical equipment, and building insulation). No additional measures are necessary to mitigate the anticipated energy use of the Green Line.

4.8.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse energy impacts are expected as a result of any of the Green Line Alternatives.

4.9 PUBLIC SERVICES AND UTILITIES

4.9.1 Affected Environment

4.9.1.1 Affected Environment – Public Services

This section evaluates the effects of the Green Line on public services located near or providing services in the vicinity of the Green Line alternative alignments. Public services analyzed include police, firefighting, emergency medical response, public and private schools, U.S. Post Offices, and solid waste collection. Several federal government facilities are also noted in the Downtown Segment, the only segment with major federal facilities within close proximity of the alignment alternatives. More specifically, public services include:

- **Police.** The Seattle Police Department's north, west, and southwest precincts provide police services for the neighborhood segments that would be served by the Green Line. Table 4.9-1 lists precincts by location.
- **Port of Seattle.** In the Interbay and SODO Segments, the Green Line project would cross property controlled by the Port of Seattle, which provides its own police services in addition to services provided by the Seattle Police Department.
- **Fire.** The Seattle Fire Department has sixteen stations that serve the communities along the Green Line alternative alignments. Table 4.9-2 lists stations that provide fire protection and emergency medical services within the segments.
- **Hospitals.** Although there are no hospitals directly on any of the Green Line alternative alignments, emergency services are provided at nine hospitals in the project area, as listed in Table 4.9-3.
- **Schools.** Table 4.9-4 lists public and private schools along the Green Line alternative alignments. School buses also use streets (such as 15th Avenue NW, NW 75th Street, NW 65th Street, and California Avenue SW) that may be affected by the Green Line project.
- **Post Office.** There is one U.S. Post Office along the Green Line route in the Interbay Segment, at 2010 15th Avenue W. There are several U.S. Post Offices located one to three blocks from the Green Line alternative alignments in the Downtown and SODO Segments.
- **Solid Waste.** Rabanco Recycling, Inc. is located one block east of the Green Line south Operations Center alternative (at the southwest corner of S Lander Street and Utah Avenue S). Solid waste disposal and recycling trucks use the same surface streets proposed for location of Green Line guideway columns and stations.

Figures 4.9-1 through 4.9-5 identify service providers in the vicinity of the Green Line alternative alignments.

Table 4.9-1. Seattle Police Precincts Serving the Green Line Route

Segment	Station	Location
Ballard	North	10049 College Way N
Interbay, Queen Anne/Seattle Center/ Belltown, Downtown, SODO	West	810 Virginia Street
West Seattle	Southwest	2300 SW Webster

Table 4.9-2. Seattle Fire Department Stations Serving the Green Line Route

Segment	Station	Location	Equipment
Ballard	35	8729 15 th Avenue NW	Engine 35
Ballard	21	7304 Greenwood Avenue N	Engine 21
Ballard	18	1521 NW Market Street	Engine 18, Hose 18, Medic 18 Ladder 8, Battalion 4
Interbay	23	Fishermen's Terminal	Engine 3 (Reserve Fireboat)
Interbay	8	110 Lee Street	Engine 8 and Ladder 6
Interbay	9	3829 Linden Avenue N	Engine 9 and Air 9
Interbay	20	3205 13 th Avenue W	Engine 20
Interbay	41	2416 34 th Avenue W	Engine 41
Downtown	2	2334 Fourth Avenue	Aid 2, Ladder 4, Engine 2, Safety 2
Downtown	10	301 Second Avenue S (department headquarters)	Aid 5, Ladder 1, Engine 10, Staff 10, Air 10, Deputy 1, and Hazardous Materials Unit
Downtown	5	925 Alaskan Way	Engine 4 (fireboat) and Engine 5
SODO	14	3224 Fourth Avenue S	S Ladder 7, Aid 14, Rescue 14
West Seattle	36	3600 23 rd Avenue SW	Engine 36 and Marine Response
West Seattle	37	7300 35 th Avenue SW	Engine 37
West Seattle	32	3715 SW Alaska Street	Medic 32, Ladder 11, Engine 32
West Seattle	29	2139 Ferry Avenue SW	Engine 29 and Battalion 7

Note: Some of the stations listed provide coverage beyond the project segment in which they are located.

Source: Seattle Fire Department (2003).

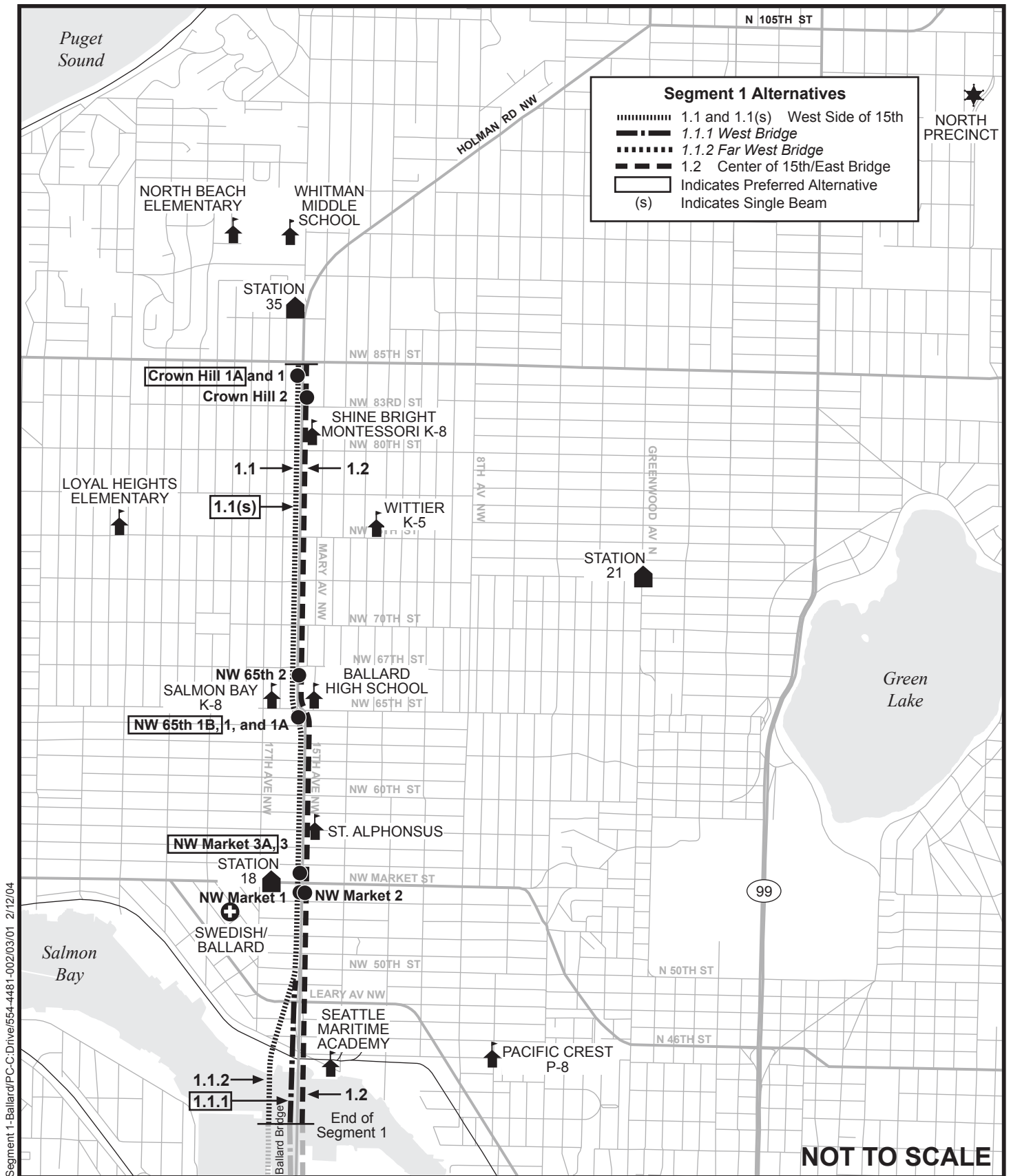
Table 4.9-3. Hospitals Serving the Green Line Route

Nearest Segment	Hospital	Location
Ballard	Swedish Medical Center/Ballard	5300 Tallman Avenue
Queen Anne/Seattle Center/Belltown	Group Health Medical Center	201 16 th Avenue E
Downtown	Harborview Medical Center	325 Ninth Avenue
Downtown	Swedish Medical Center	747 Broadway
Downtown	Swedish Medical Center at Providence	500 17 th Avenue
Downtown	Providence Health Systems	506 Second Avenue
Downtown	Virginia Mason	925 Seneca Street
Downtown	Regence Care & Clinical Options	1800 Ninth Avenue
SODO	Pacific Medical Center	1101 Madison

Table 4.9-4. Public and Private Schools within the Vicinity of the Green Line Alternative Alignments

Segment	School	Location
Ballard	North Beach Elementary	9018 24 th Avenue NW
Ballard	Whitman Middle School	9201 15 th Avenue NW
Ballard	Shine Bright Montessori	8015 15 th Avenue NW
Ballard	Loyal Heights Elementary	2511 NW 80 th Street
Ballard	Whittier K–5 Elementary	1320 NW 75 th Street
Ballard	Salmon Bay K–8	1810 NW 65 th Street
Ballard	Ballard 9–12 High School	15 th Avenue NW/NW 65 th Street
Ballard	Saint Alphonsus	5816 15 th Avenue NW
Ballard	Seattle Maritime Academy	4455 Shilshole Avenue NW
Ballard	Pacific Crest	600 NW Bright Street
Interbay	Lawton Elementary	4000 27 th Avenue W
Interbay	Seattle Country Day School	2619 Fourth Avenue N
Interbay	Coe Elementary	2424 Seventh Avenue W
Interbay	McClure Middle School	1915 First Avenue W
Interbay	John Hay Elementary	201 Garfield Street
Interbay	St. Anne	101 W Lee Street
Queen Anne/Seattle Center/Belltown	Center High School	Center House, Seattle Center
Downtown	Gatzert Elementary	1301 East Yesler Way
SODO	Beacon Hill Elementary	2025 14 th Avenue S
West Seattle	West Seattle High School	3000 California Avenue SW
West Seattle	West Seattle Montessori	4536 38 th Avenue SW
West Seattle	Seattle Lutheran	4141 41 st Avenue SW
West Seattle	Hope Lutheran	4446 42 nd Avenue SW
West Seattle	West Seattle Christian	4401 42 nd Avenue SW
West Seattle	Holy Rosary School	4142 42 nd Avenue SW
West Seattle	Pathfinder Elementary	5012 SW Genesee Street
West Seattle	Cooper Elementary School	1901 SW Genesee Street
West Seattle	Fairmount Park K–5	3800 SW Findlay Street
West Seattle	Gatewood K–5 Elementary	4320 SW Myrtle Street
West Seattle	High Point Elementary	6760 34 th Avenue SW

Sources: Seattle School District Web Site (2003), Seattle Times School Guide (2003).

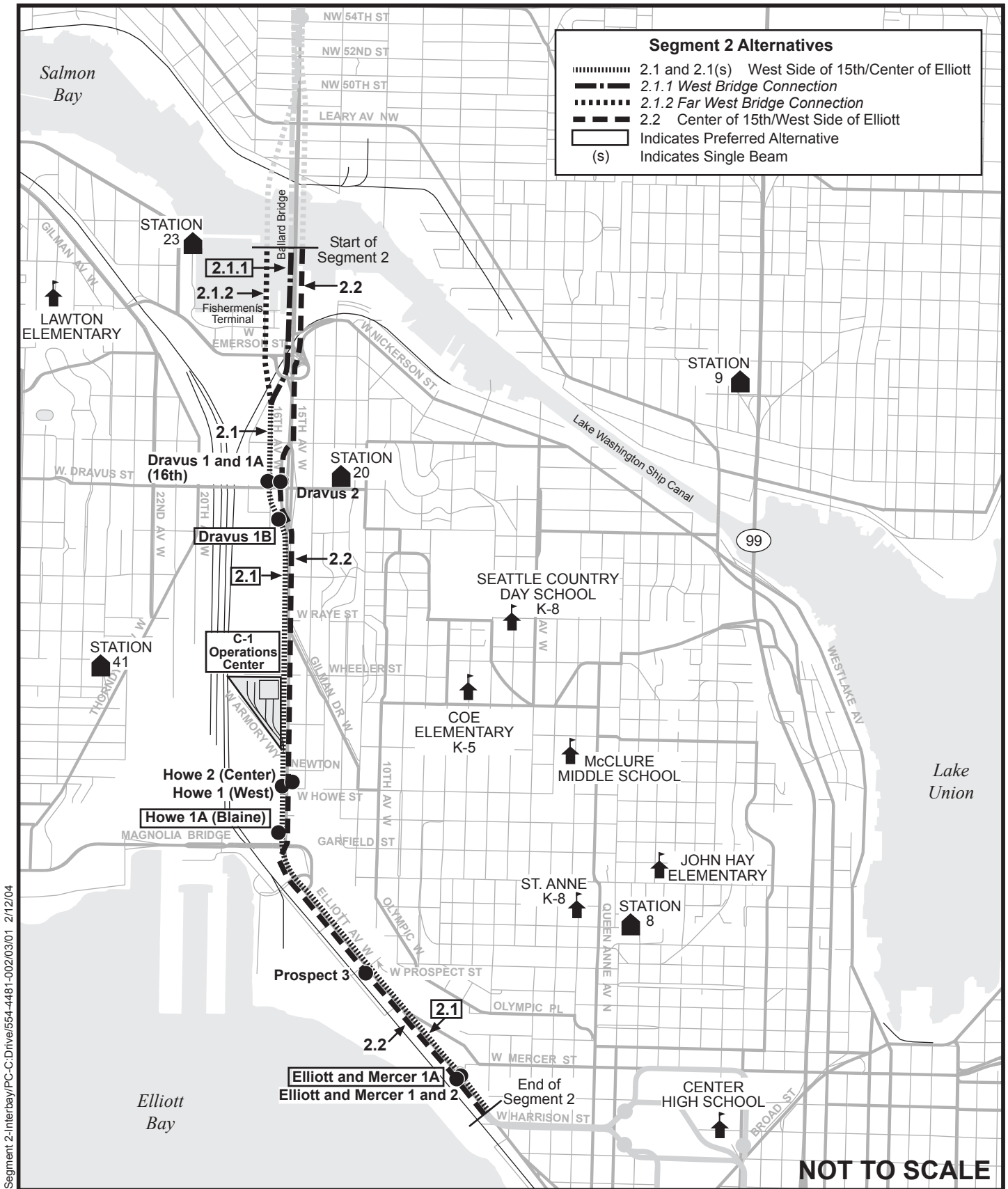


Segment 1-Ballard/PC-C:Drive/554-4481-002/03/01 2/12/04



- ★ Police
- 🏠 Firestations
- ⛑ Hospitals
- 🏫 Schools

Figure 4.9-1
Segment 1: Ballard
Public Services



Segment 2-Interbay/PC-C:Drive/654-4481-002/03/01 2/12/04



- ★ Police
- 🏠 Firestations
- ⛑ Hospitals
- 🎓 Schools

Figure 4.9-2
Segment 2: Interbay/Magnolia
Public Services

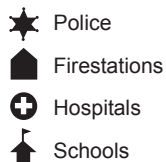
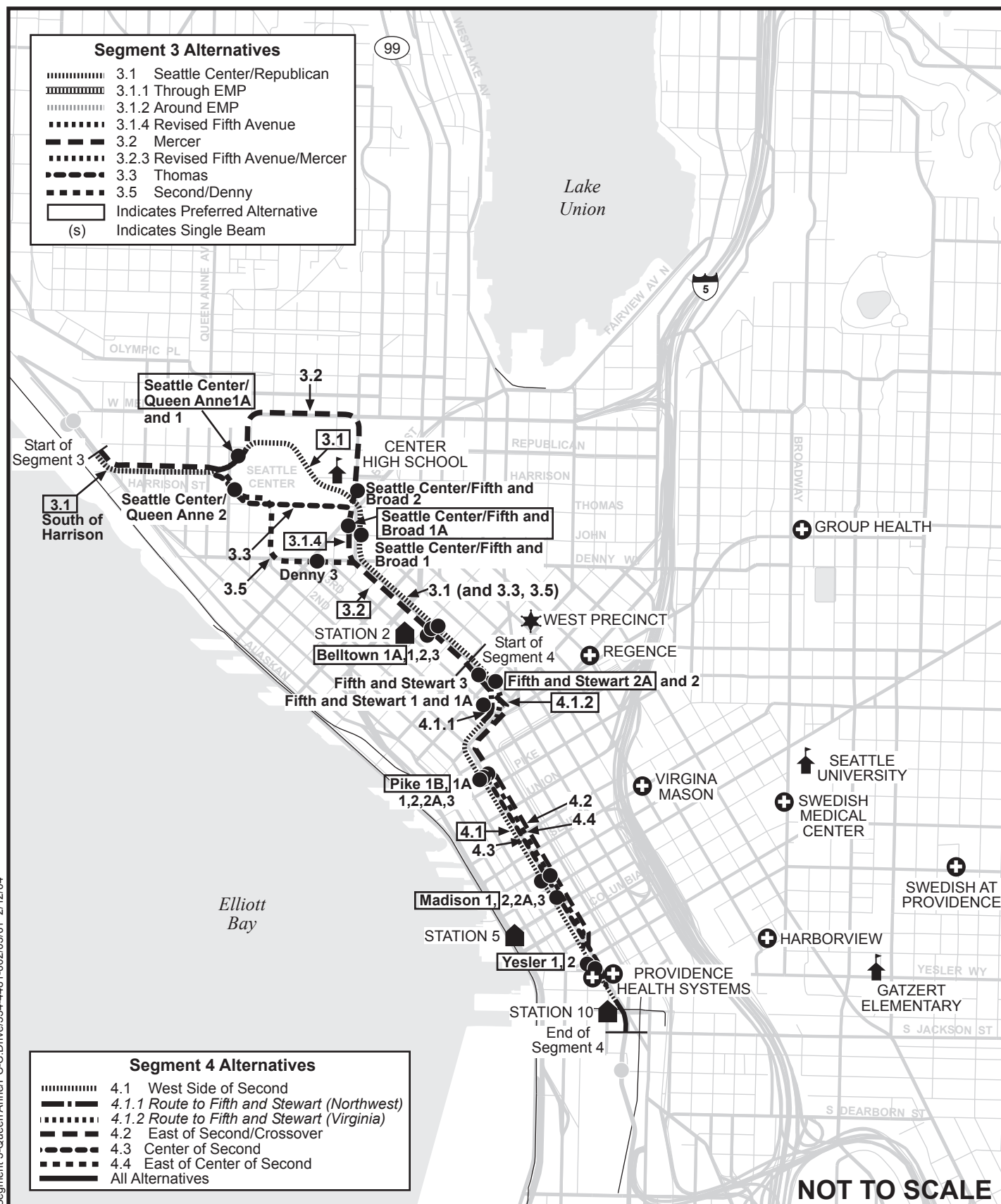
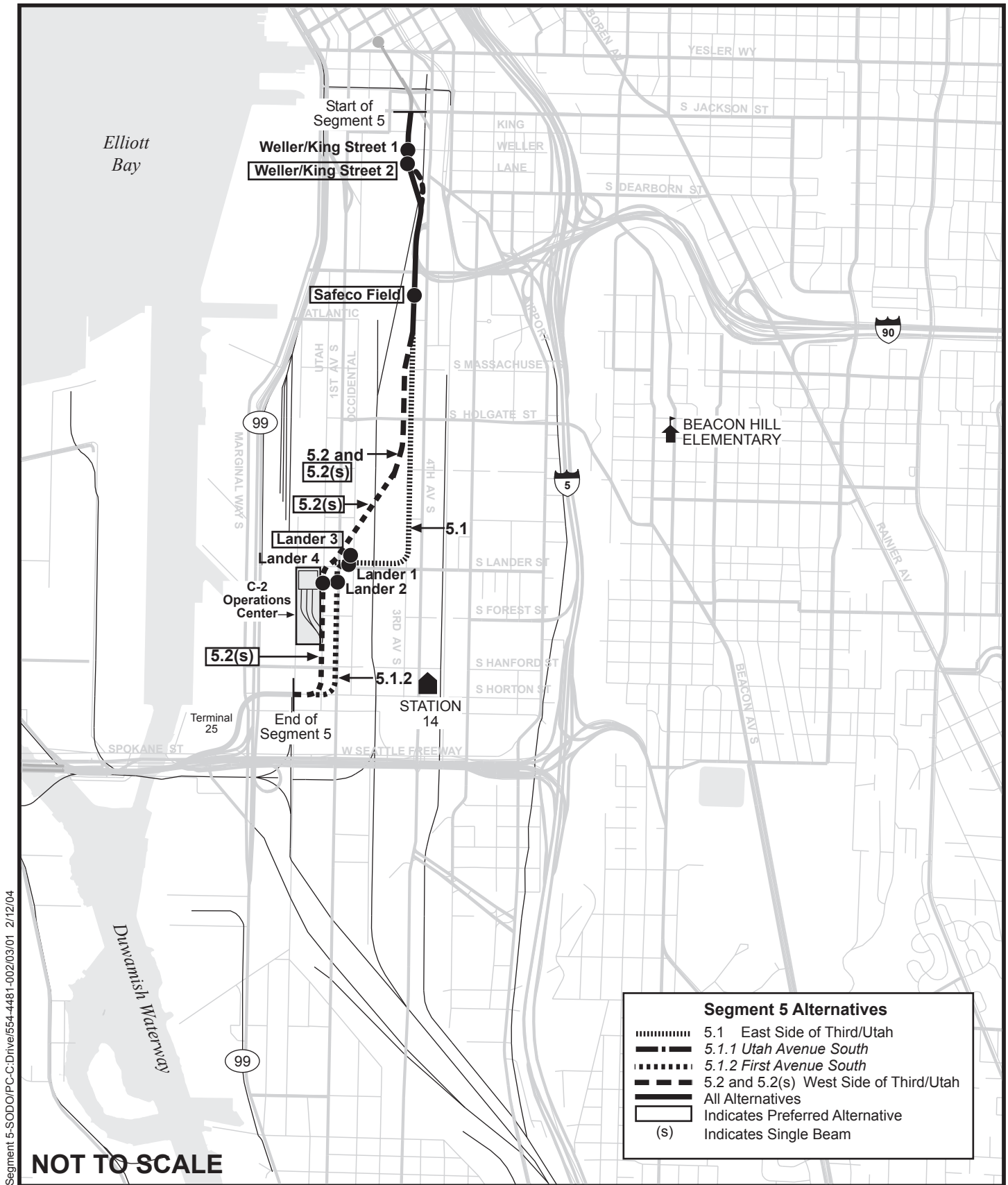


Figure 4.9-3
Segments 3 and 4: Queen Anne/
Seattle Center/Belltown and
Downtown/Pioneer Square
Public Services



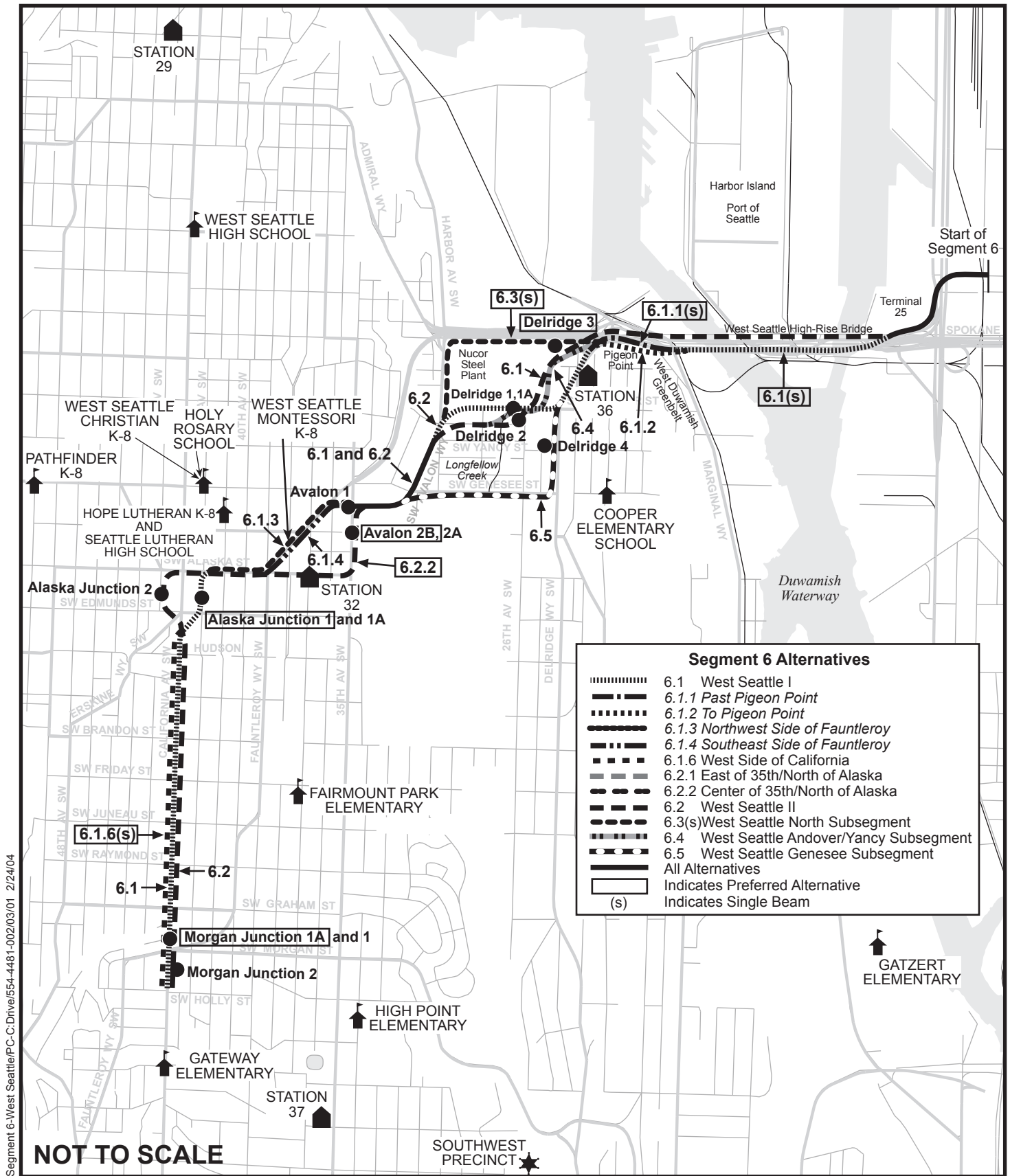
Segment 5-SODO/PC-C:Drive/554-4481-002/03/01 2/12/04



- ★ Police
- 🏠 Firestations
- 🏥 Hospitals
- 🎓 Schools



Figure 4.9-4
Segment 5: SODO/Chinatown
International District/Pioneer Square
Public Services



Segment 6-West Seattle/PC-C:Drive/554-4481-002/03/01 2/24/04



- ★ Police
- 🏠 Firestations
- ⛑ Hospitals
- 🎓 Schools

Figure 4.9-5
Segment 6: West Seattle
Public Services

4.9.1.2 Affected Environment – Utilities

There are a number of utility providers along the Green Line alignment alternatives, including municipal agencies and private companies that provide electricity, water, wastewater and stormwater collection, natural gas, and telecommunications services. The construction and operation of the Green Line would be largely within public street rights-of-way, where utilities are generally located.

The existing utilities in the six segments are discussed in more detail in Section 4.17, Construction. However, major utility providers in the project area, which is entirely within the city of Seattle, are the same regardless of the segment. The major providers in the project area include:

- **Electrical Service.** Seattle City Light (City Light), a department of the City of Seattle, provides electric power to more than 345,000 customers in a 131.1-square-mile service area that includes Seattle and portions of King County. City Light owns nearly 1,900 megawatts of hydroelectric generation capacity and owns or contracts approximately 80 percent of its hydroelectric generating needs (City Light 2003a). A City-owned circuit of 657 miles of transmission lines carries power from the generating facilities to 14 major substations and 12 unit substations. City Light also owns and maintains a distribution circuit of 3,100 miles (City Light 2003b). In the study area, the City Light system uses a combination of electrical transmission and distribution lines. The transmission lines are typically 34 to 240 kilovolts (kV) arranged with a set of three conductors placed in-line (spaced 5.5 feet), while distribution lines range between 4 to 26 kV under the same configuration (BERGER/ABAM 2003a). Notable underground electrical duct banks (EDs) are located along the west side of Second Avenue. Overhead transmission lines are located crossing S Massachusetts and Third Avenue S, at the east approach to West Seattle Bridge, and at Utah Avenue S and S Hanford Street.
- **Water Supply.** Seattle Public Utilities (SPU) provides potable (drinkable) water to nearly 600,000 people in Seattle and surrounding areas. Two water sources, the 90,000-acre Cedar River Watershed and the 13,300-acre South Fork Tolt River Watershed, provide most of the service area's annual average consumption of 145 million gallons per day (SPU 2000). The system consists of transmission and distribution mains, fire hydrants, water meters, service lines, and water valve chambers. In the project area, the primary water mains range in size between eight and 20 inches and are typically located along the east side of north-south streets (BERGER/ABAM 2003a,c).
- **Sanitary Sewer and Stormwater.** SPU owns, operates, and maintains sewer collection facilities, including pipelines and other wastewater conveyance facilities, in Seattle. SPU inspects, repairs, operates, and maintains wastewater (sewer) pipes and pump stations in the project area to protect public health and avoid property and environmental damage from sanitary sewer overflows and combined sewer system overflows (SPU 2001). The King County Department of Natural Resources Wastewater Treatment Division provides sewage treatment services throughout the project area and also owns, operates, and maintains regional sewer conveyance pipelines. Wastewater in the project vicinity is conveyed to King County's West Point Treatment Plant, which operates at a capacity of 133 million gallons per day (King County 2003). Sewer mains in the project area range in size from eight to 24 inches, with a 30-inch line along SW Andover and a 36-inch line along the west side of Third Avenue. Other primary sewer mains in the project area are located along the center of 15th Avenue NW, west side of 15th Avenue W, center of Elliott Avenue, and the center of Utah Avenue S. Within the Downtown Segment, a 102-inch Metro combined sewer tunnel is located along the center of Second Avenue from Stewart Street to S Washington Street. The depth of this tunnel ranges from approximately

150 feet at Stewart Street to approximately 35 feet at S Washington Street (BERGER/ABAM 2003a,c).

Stormwater in Seattle is collected by storm sewers; a combined stormwater and wastewater system; or through a ditch, culvert, and creek system. SPU operates and maintains these drainage systems and also constructs new trunk lines and detention ponds to alleviate flooding problems. In the project area, the primary storm drains range in size between 8 and 21 inches and are located along the west side of 15th Avenue NW, west side and center of 15th Avenue W, west side of Elliott Avenue W, and the east side of Utah Avenue S (BERGER/ABAM 2003a,c).

- **Natural Gas.** Puget Sound Energy (PSE) provides natural gas service throughout the project area. PSE serves more than half of the residents of Washington State over a 6,000-square-mile service area. Their 620,000 natural gas customers are primarily in Western Washington (PSE 2003a,b). Natural gas pipes are located within the project vicinity in each segment. The primary high-pressure lines are located along Elliott Avenue W and 35th Avenue SW. Other major lines are located along 15th Avenue NW, 15th and 16th Avenues W, Elliott Avenue W, Utah Avenue S, Second and Third Avenues, SW Alaska Street, and SW Andover Street (BERGER/ABAM 2003a,c).
- **Steam.** Seattle Steam, a privately held company operating in agreement with the City, maintains 18 miles of piping in a one-square-mile area of Downtown Seattle. Steam distribution lines within the project area include a 12-inch intermediate pressure line traveling north and south along First Avenue. Steam is pumped through four main boilers with operating pressures of 140 pounds per square inch. Average production in the winter peak season is nearly 500,000 pounds of steam per hour, with a 100-pound-per-hour average in the summer (PSBJ 2001). Within the project area, the primary steam pipes range between eight and 12 inches in size (not including insulation) and are located along Stewart Street and Second Avenue (BERGER/ABAM 2003a,c).
- **Telecommunications/Fiber Optics.** Qwest provides local telephone service in the project vicinity and has fiber-optic lines in the project area. Several private companies and public utilities also own fiber-optic cable and/or provide long-distance and other telecommunication services in the general project area. Fiber-optic lines in the project area are primarily concentrated within the Queen Anne/Seattle Center/Belltown, Downtown, and SODO Segments. Many of the fiber-optic lines utilize deactivated gas pipes for conveyance. The City of Seattle Department of Information Technology (DoIT) also provides telecommunications, telephone, data network capability, and cable management services in the project area. DoIT provides a data network connecting all of the City's computers and departments together and connecting them to the Internet. DoIT also operates and maintains the City's private telephone network (about 12,000 telephones), voicemail, telephone management system, and the City's telecommunications (telephone and data networking) functions (Seattle, City of 2003a).
- **Traffic Signal Optimization Program.** Seattle Department of Transportation (SDOT) operates signals within the Green Line project area and within the Seattle city limits, including over 975 signalized intersections, three quarters of which are on major transportation corridors such as Aurora Avenue N, Delridge Way SW, Rainier Avenue S, and in the entire Downtown area (Seattle, City of 2003). The Signal Optimization Program is a coordinated effort designed to make the most efficient use of our city's traffic signals by improving signals, gathering up-to-date traffic data, and taking advantage of new technologies. Optimization refers to all maintenance, upgrades, timing adjustments, and other efforts to improve signalization (Seattle, City of 2003b).
- **Seattle Center.** The Seattle Center operates a public and private utility system that serves the 74-acre site, which is home to a variety of venues and facilities, including Pacific Northwest Ballet, Key Arena, Seattle Center Monorail, Space Needle, Experience Music Project, Memorial Stadium, Seattle Children's Theater, and others. The Seattle Center operates a combination of

utilities, including power, water, sewer, storm, natural gas, and steam. Telephone, fiber optic, and cable are also located in this area. Both Seattle Center and Qwest own and maintain underground telecommunications in this area, with major lines along Thomas Street, while SPU owns, operates, and maintains the water system serving this site. The 26 kV electrical distribution system that serves the campus is owned, operated, and maintained by Seattle City Light. The utility systems in the Seattle Center Segment are typical of the utilities found in the project area and include power, natural gas, water, sewer, stormwater, steam, and telecommunications/ fiber optic services.

4.9.2 Impacts

4.9.2.1 Long-Term System Impacts – Public Services

Impacts from operation of the Green Line on public services could involve either the physical placement of the project on or adjacent to a public service facility or a change in the operating environment of the public service. In some cases, the location of the project could also affect the level or type of services (such as police or emergency services) that may be provided. Some of the alternatives for Green Line stations, facilities, or guideway alignments could require the acquisition of publicly owned property, but overall acquisitions of such properties are low for all alternatives. Throughout most of the Green Line alignment, the same emergency service providers would respond to a call at any given station or alignment section regardless of the alternative. To the extent that differences among alignment and station alternatives result in different impacts, those impact differences are noted. Further, see Section 4.17-Construction for a discussion of construction impacts and mitigation.

The majority of the differences between alternatives involve location-specific changes in access to or by public services through the placement of Green Line routes or stations and through related roadway changes and transportation conditions. In most cases, the demand for services would be similar among alternatives and the analysis focuses on the relative change from No Action conditions.

In terms of access to public services along the Green Line, analysis indicates that access to some public services could be enhanced because of the Green Line. For example, there are schools within the vicinity of the proposed stations in the Ballard, Queen Anne/Seattle Center/Belltown, and West Seattle Segments of the Green Line project whose students could use the monorail for access. The Green Line could also result in an overall beneficial effect on access to public services by providing enhanced mobility.

Access by public services (specifically response times for some public services such as police, firefighting, and emergency medical aid) may be affected by placement of guideway columns. Impacts would be greater for center alignment alternatives for the guideway because left turn movements may be more difficult or may be prohibited at some intersections, mid-block or driveway access could be restricted to right-in/right-out movements, and because emergency vehicles often use a center left-turn lane as a through travel lane to avoid traffic congestion. Emergency services could be impacted if a monorail train gets stuck under or near to a Seattle City Light feeder that has only the minimum NESC safety clearance. If there is not enough clearance for emergency personnel to work safely, extra time would be required for Seattle City Light to de-energize and clear the lines, if possible. Specific recommendations for improving vehicle access and circulation in locations where guideway columns would be provided in an existing center two-way left turn lane are identified in the Transportation Mitigation section (Section 4.1.3). The SMP design team will coordinate with providers to determine the alternative with the least impact to emergency services routes during both construction and operation. In most locations along the project, parallel arterials may provide alternative routes if needed. The exception is in the Interbay Segment, where 15th Avenue W and Elliott Avenue W do not always have adjacent parallel routes. For these streets, center alignments would involve comparatively more

restrictions than alignments on the west side of the streets. However, provision for U-turns or provision of mountable curbs (so that emergency vehicles could drive over the median beneath the guideways, if necessary) would minimize potential delays or increases to response times (see Section 4.1.6 for additional information).

The potential impact of the Green Line on response times is difficult to quantify because response time is dependent on a large number of variable factors, such as time of day, degree of traffic congestion, types of uses in the neighborhood, extent of construction activity in the neighborhood, and how response time is calculated. Average citywide response times for the Seattle Fire Department fire, rescue, and hazardous material calls, for example, have varied from a low of 4.01 minutes in 1995 to a high of 4.24 minutes in 2002.

Delay of vehicles due to reduction in level of service (LOS) at intersections throughout the project has been analyzed and is discussed in Section 4.1, Transportation (for mitigation of these impacts on Green Line operations, see Section 4.1.3 and for mitigation of construction impacts, see Section 4.17 Construction). The Green Line may result in delay of emergency vehicles due to worsening LOS ratings at the following intersections:

- In the Ballard Segment, Alternatives 1.1, 1.1(s), and 1.2 may result in increased delays for intersections along 15th Avenue NW at NW Market, NW 65th, NW 80th, and NW 85th Streets. (Within this segment, the eastbound approach of the 15th Avenue NW and Holman Road NW intersection is already operating at an unacceptable LOS during the a.m. peak hour.)
- In the Interbay Segment, Alternatives 2.1, 2.1(s), and 2.2 may result in increased delays at W Dravus Street and 16th Avenue W, the 15th Avenue W ramp terminal intersections with W Dravus Street, and the Elliott Avenue W/W Mercer Place intersection.
- In the Queen Anne/Seattle Center/Belltown Segment, Alternative 3.5 (Second/Denny) may result in delays at Denny Way and Broad Street, particularly in the p.m. peak hour. Alternative 3.5 may also result in delays at Denny Way and Fifth Avenue during the a.m. peak hour.
- In the Downtown Segment, none of the Green Line alignment alternatives would significantly worsen intersection operation.
- In the SODO Segment, intersection LOS is expected to remain similar to the No Action conditions.
- In the West Seattle Segment, the Avalon 1 (Center) station alternative (Alternative 6.1) may result in delays at Fauntleroy Way SW and SW Avalon Way, as well as at 35th Avenue SW and SW Avalon Way.

A few of the alternatives may eliminate travel lanes, thereby reducing roadway capacity and potentially increasing emergency response times. Alternatives with streets that may be impacted due to loss of one or more travel lanes could include the following:

- Alternative 1.1 (West Side of 15th) or 1.1(s) (West Side of 15th single beam) in the Ballard Segment would eliminate one southbound and one northbound parking/peak travel lane currently open to traffic from 7:00 to 9:00 a.m. on 15th Avenue NW between NW 85th Street and NW 65th Street.
- Alternative 2.1 (West of 15th/Center of Elliott) or 2.1(s) (West of 15th/Center of Elliott single beam) would remove a southbound parking/peak travel lane on 15th Avenue W south of W Dravus Street. Alternative 2.2 (Center of 15th/West Side of Elliott) in the Interbay Segment would eliminate one southbound travel lane currently open to traffic from 7:00 to 9:00 a.m. on Elliott Avenue W between the Magnolia Bridge and W Morrison Street.

- Alternative 3.2 (Mercer) would eliminate one travel lane on Fifth Avenue. Alternative 3.5 (Second/Denny) in the Queen Anne/Seattle Center/Belltown Segment would eliminate one eastbound travel lane on Denny Way between Second Avenue and Fifth Avenue.
- In the Downtown Segment, all alternatives would eliminate one travel lane on Stewart Street.
- Alternative 5.1.2 (First Avenue S) in the SODO Segment would eliminate one southbound travel lane currently open to traffic from 4:00 to 6:00 p.m. on First Avenue S between S Lander Street and S Horton Street.

For center alignments, placement of monorail guideway columns would generally eliminate center two-way left turn lanes. This would result in reduced left-turn opportunities to and from unsignalized side streets. In locations where guideway columns would be placed in the center of one-way streets, vehicles could be prohibited from passing between columns to change lanes. These vehicular access restrictions could result in some out-of-direction travel for emergency vehicles, which could increase emergency response times. Emergency vehicles could also be affected because some of them currently use center left-turn lanes as through lanes to avoid traffic congestion and travel more quickly during emergency situations.

Placement of guideway columns could eliminate the center two-way left turn lane along the following streets:

- Alternative 1.2 (Center of 15th) in the Ballard Segment would eliminate the center turn lane on 15th Avenue NW, but would maintain northbound right-turn only lanes at NW 65th, NW 80th and NW 85th Streets
- Alternative 2.1 or 2.1(s) (West Side of 15th/Center of Elliott) in the Interbay Segment would eliminate the center turn lane on Elliott Avenue W. A new signal at W Lee Street would allow U-turn movements.
- Alternative 2.2 (Center of 15th/West Side of Elliott) in the Interbay Segment would eliminate the center turn lane on 15th Avenue W.
- Alternative 6.1 (West Seattle I) in the West Seattle Segment would eliminate the center turn lanes on SW Avalon Way and California Avenue SW.
- Alternative 6.2 (West Seattle II) in the West Seattle Segment would eliminate the center turn lanes on SW Avalon Way. Alternative 6.2.2 would eliminate the center turn lane along 35th Avenue SW.

One-way streets potentially affected by placement of guideway columns down the center of the street include:

- Alternatives 3.1 (Seattle Center/Republican), 3.3 (Thomas), and 3.5 (Second/Denny) in the Queen Anne/Seattle Center/Belltown Segment would place guideway columns down the center of Fifth Avenue through Belltown (in place of existing monorail columns).
- Alternative 4.3 (Center of Second) and 4.4 (East Center of Second) in the Downtown Segment would place guideway columns down the center of Second Avenue. (These columns would have special straddle foundations underground to avoid conflict with a major underground utility).

Regardless of the alignment alternative, planning to respond to emergencies on Green Line trains, at stations, or along the guideway could place new or different demands on emergency service providers. Emergency services could potentially be required for events such as a medical emergency, fire, or natural disaster at any of the stations, the Operations Center, or along the guideway. The Green Line would be

designed to provide a means of exiting a train in the event of an emergency stop and evacuation anywhere on the alignment, allowing passengers to reach a safe haven, either on the ground or at a nearby station. However, special procedures, training, or equipment may be required to address emergency access to trains on the guideway, particularly on the Ship Canal crossing in the Ballard Segment and on the Duwamish River crossing if a new, monorail-only bridge is constructed.

In terms of firefighter access to the monorail guideway and to adjacent buildings during an emergency, the Seattle Fire Department has indicated that (with exceptions in a few areas) ladders could reach over the guideway if needed (Conley 2003). However, it should be noted that ladders would be used to reach the guideway only as a last resort, and only after traction power has been disconnected. Additionally, the guideway itself could compromise firefighter's ability to fully access adjacent buildings with aerial ladders. In these instances, ground-based ladders would be used.

At the Federal Office Building on Second Avenue, Green Line guideways could potentially complicate surveillance and security measures due to reduced visibility from the street because of guideway and station supports and larger numbers of people moving around the entries to the building. Neither the guideway nor the stations in any segment are expected to adversely affect any U.S. Post Office.

Acquisition of public property would be required for some segments. For Alternative 1.2 (Center of 15th) in Ballard, a partial acquisition or air rights could be required from the Seattle Central Community College Maritime Training Center. However, it is expected that use of the property by the Maritime Training Center would not be affected. A portion of the property at Fire Station 36 in West Seattle would be acquired for placement of guideway columns for Alternative 6.1.2 (To Pigeon Point). Exact location of columns would be coordinated with Seattle Fire Department to avoid potential impacts. Similarly, Fire Station 32 could be affected by construction of a new, monorail-only bridge with Alternative 6.2 (West Seattle II). Station 32 has not been identified as a property acquisition need at this time, but SMP will coordinate with Seattle Fire Department on column placement to avoid impacts to services. A partial acquisition of the Department of Social and Health Services (DSHS) building parking lot and planting area at 4045 Delridge Way SW would be required for the Delridge 4 Station and alignment Alternative 6.5. Further discussion of the impacts to public properties can be found in Section 4.2, Displacements and Relocation.

In terms of Green Line operations and security at stations, SMP intends to hire security staff to patrol Green Line stations and trains and will develop a security plan for Green Line operations. In addition, incorporating principles of Crime Prevention Through Environmental Design (CPTED), such as strategic lighting, clear sightlines on the station platforms, and overall station site design, could enhance public safety at Green Line stations.

The Preferred Alternative evaluated in this Final EIS would include single-beam guideway operations in portions of the Ballard, SODO, and West Seattle segments. With the single-beam configuration, both northbound and southbound trains would operate on the same guideway requiring trains to pass each other at stations and dual-beam guideway segments. The Green Line system is in a class of technology called Automated Guideway Transit (AGT). These systems rely on technology to achieve safety goals and minimize the need for human action, and thus the risk of human error.

Safety issues will be addressed in a safety plan developed to identify, assess, and mitigate potential safety hazards. A hazards analysis that incorporates a rigorous process to identify all of the possible events that could result in an unsafe condition is a central component of the safety plan. The hazards analysis will identify portions of the operating system as being vital to system safety. These items must be designed, manufactured, and installed in accordance with the safety plan making failures resulting in unsafe conditions virtually impossible.

No public safety issues related to the single-beam guideway are anticipated, as the Green Line will have an automated control system (ATC) that monitors every train and its location at all times. Before a train is permitted to depart from a station, it must “request” a route to another position on the guideway (usually another station). Before the ATC system “permits” the train to move, it must establish the route and verify that (1) all switches on that route are properly aligned and locked, (2) no other trains occupy any portion of that route, (3) no other trains have routes that are in conflict, and (4) no other safety issues (such as guideway intrusions) exist. Historically, ATC systems have achieved safety performance levels that significantly exceed those of manually operated systems. The single-beam segments recommended as part of the Preferred Alternative would not introduce any decrease in the anticipated safety performance of the system compared to dual-beam segments. For more information on the operation of single-beam guideways and examination of existing single-beam systems, see the Single Beam Guideway Description included in Volume 2, Appendix LL of this Final EIS.

Preferred Alternative (Impact Summary)

In the Ballard Segment, the Preferred Alternative is a single beam configuration along the west side of 15th Avenue NW (Alternative 1.1(s)). Due to increased congestion and degraded LOS conditions, Alternative 1.1(s) may result in travel time delays for intersections along 15th Avenue NW at NW Market, NW 65th, NW 80th, and NW 85th Streets. Alternative 1.1(s) would also eliminate one southbound and one northbound off-peak parking/peak travel lane currently open to traffic from 7:00 to 9:00 a.m. on 15th Avenue NW between NW 85th Street and NW 65th Street. The elimination of one southbound and northbound off-peak parking/peak travel lane could result in response time impacts at this location, particularly during peak periods. Compared to the center of street alignment analyzed in Alternative 1.2, however, the Preferred Alternative would result in smaller travel time impacts and fewer restrictions for emergency providers.

In the Interbay Segment, the Preferred Alternative is a dual beam configuration along the west side of 16th Avenue W, the west side of 15th Avenue W, and the center of Elliott Avenue W with an Operations Center west of 15th Avenue W (Alternative 2.1). Due to increased congestion and degraded LOS conditions, Alternative 2.1 may result in travel time delays at W Dravus Street and 16th Avenue W, the 15th Avenue W ramp terminal intersections with W Dravus Street, and Elliott Avenue W and W Mercer Place. Alternative 2.1 would also remove a southbound parking/peak travel lane on 15th Avenue W south of Dravus and eliminate the center turn lane on Elliott Avenue W. The elimination of the center turn lane could result in response time impacts at these locations. In particular, the 15th Avenue W (south of Dravus) location would be affected during peak periods.

In the Queen Anne/Seattle Center/Belltown Segment, the Preferred Alternative would travel through Seattle Center along the path of Republican Street and then along the west side of Fifth Avenue through Belltown. The elimination of one travel lane on Fifth Avenue due to the guideway column placement could result in response time impacts. Compared to the alternative placing the guideway in the center of the street, however, the Preferred Alternative would have less impacts on response times.

In the Downtown Segment, the Preferred Alternative would travel west on Stewart Street and proceed south along the west side of Second Avenue (Alternative 4.1). It would eliminate one travel lane on Stewart Street, but would not significantly worsen intersection traffic operations, and would have the smallest impacts of any alternatives studied.

In the SODO Segment, the Preferred Alternative would travel in a diagonal alignment along the west side of Third Avenue S and Utah Avenue S. Intersection LOS conditions are expected to remain similar to the No Action LOS conditions.

In the West Seattle Segment, elimination of the center turn lanes on SW Avalon Way and 35th Avenue SW (between SW Avalon Way and SW Alaska Street) for the Preferred Alternative could result in response time impacts. The Preferred Alternative is anticipated to have relatively smaller impacts on California Avenue SW because it would not restrict movement in that corridor.

4.9.2.2 Long-Term System Impacts – Utilities

This section addresses impacts to utilities related to long-term operation of the Green Line. For construction impacts of utility relocation, please refer to Section 4.17, Construction. The Green Line system has the potential to cause direct and indirect impacts to utility services and infrastructure during operation. Longer-term operational impacts could include the potential for additional power infrastructure to serve the Green Line system, and potential conflicts with existing utility maintenance and replacement operations. See Section 4.17.10.2 for a discussion of utility relocation and utility impacts from construction of Green Line alternative alignments and stations.

This analysis of utility impacts focuses on utilities in close proximity to the Green Line alignment alternatives and provides a relative comparison of the level of impacts that could be expected for the different alignment and station alternatives. The basis for the utility analysis was the BERGER/ABAM overhead and underground utility relocation plans, tables, and cost estimates prepared for SMP, dated June 2003. This documentation is hereby incorporated by reference (BERGER/ABAM 2003a–f) (see Table 4.17-8 in the Construction section for a summary of this information).

Placement of guideway columns could complicate long-term maintenance of underground utilities when the guideway or other structures are in the immediate vicinity of the utility, although utility location will be one factor used to determine column placement. Guideway beams will typically span intersections to avoid cross-section utility impacts. Where foundations or guideway beams might limit access, these will be addressed on a case-by-case basis during final design. However, no significant adverse impacts to natural gas, telephone, telecommunications, water supply, wastewater, drainage, steam, or solid waste collection and disposal services would be expected during operation of the Green Line under any of the alternatives.

Underground gas, water, and sewer lines and other pipes and conduits beneath columns would not likely be affected by the weight of elevated segments because potentially affected utilities would be relocated or otherwise protected before or during construction. Concerns have been expressed that settling of elevated sections could affect underground utilities. However, it is unlikely that any settling would occur because the Green Line must have secure foundations, and foundations would be engineered to ensure that no settling occurs. Design and construction of foundation systems would not create loads or settlement of utilities or pipes.

As discussed in Section 4.8, Energy, the Green Line would be replacing fossil fuel sources for transportation, but would increase the electricity demand and consumption on the existing electrical system in the project area. Power demand for the Green Line operation would not significantly affect sources of electrical energy available to City Light, although upgrades to some transmission line and power substations may be required due to limited capacity of the existing distribution infrastructure. Section 4.8 includes a more detailed analysis of power supply and the Green Line's estimated power needs. Primary power would likely be provided to the monorail trains and stations from electrical feeds generated by either the Canal or Delridge substations.

Electrical power to the Green Line system could create the potential for stray current, which could accelerate the corrosion of underground utilities (i.e., buried metal pipes and conduits). Stray current is guideway power rail DC current that has found an alternate path (not through the power rails). Stray

current is eliminated through isolation of the power rails and possibly redundant power cabling. Stray current monitoring equipment is part of the guideway power system design and is located in the guideway power stations (SMP 2003c). In addition, design of the elevated guideway system and its structures would have lower potential for stray current compared to an at-grade or underground system, and the Green Line could incorporate cathodic protection devices within the structures and piers/foundations to further minimize the potential for stray current to be transmitted to underground utilities.

4.9.2.3 Impacts of No Action Alternative

No impacts on public services would occur under the No Action Alternative. However, access to schools (particularly Shine Bright Montessori, St. Alphonsus, and Ballard High School in the Ballard Segment and Center High School in the Queen Anne/Seattle Center/Belltown Segment) could be enhanced with the Green Line compared to the No Action Alternative.

No significant adverse impacts to Seattle utility services or infrastructure would occur under the No Action Alternative.

4.9.3 Mitigation

4.9.3.1 Mitigation of Long-Term Impacts – Public Services

Because the Green Line would be elevated, it is anticipated to have only minimal impacts to mobility along surface streets other than those specifically noted in Section 4.9.2.1. The Green Line could change access to or from public services, but effective transportation service and circulation could be maintained through provision of left turns at intersections and the ability to make u-turns or circular routes. Increases in emergency services response times could be further minimized through coordination of project design and emergency response route planning, and by the potential for medians to be designed to allow emergency vehicles to cross, or by the provision of u-turns at selected locations. The impact on response times for emergency vehicles could be partially mitigated through the use of intelligent traffic control technology as approved by the Seattle Fire Department and Seattle Department of Transportation. Analysis indicates that the Green Line may improve access to some public services such as to schools along the alignment.

In terms of impacts to public services resulting from increased demand caused by the Green Line itself, SMP intends to prepare a Safety and Security Plan for operations to minimize increased demand on public services. Monorail trains would be designed to minimize the possibility of accidental fire and include a minimal amount of combustible material. Emergency response time could be longer if a Green Line train becomes disabled under or near a Seattle City Light feeder line that has only the minimum NESC safety clearance. If there is not enough clearance for emergency personnel to work safely, extra time could be required for Seattle City Light to de-energize and clear the lines.

SMP also intends to incorporate principles of Crime Prevention Through Environmental Design into the design of stations and structures to maximize public safety at and around stations. Security personnel and closed-circuit television could be used to provide additional security at stations, particularly at the Ballard NW 65th, Seattle Center/Queen Anne, Weller Street, and Safeco Field stations during major events.

Additionally, SMP intends to participate in emergency and security planning with local, regional, and federal authorities to enhance preparedness for a wide range of potential risks, including natural disasters, accidents, and terrorist activities.

SMP is also part of a Fire and Life Safety Committee that includes the Seattle Fire Department, the Seattle Police Department, and other City of Seattle representatives. This standing committee would address fire and life safety issues throughout the project.

Emergency egress walkways may be installed along the guideway to provide for evacuation in the event of an emergency. The Fire and Life Safety Committee would review the design of the walkways, including access to and from train cars and stations. Special procedures may need to be developed and could be reviewed by the Fire Safety Committee and included in a safety and security plan to ensure the safety of firefighters and Green Line passengers in the event of a fire.

4.9.3.2 Mitigation of Long-Term Impacts – Utilities

Green Line operation is expected to cause minimal impacts to utilities over the long term based on the design aspects of the system, and in part, compliance with:

- City of Seattle and Washington State energy, building, fire, and other applicable code requirements for all design aspects of Green Line systems, stations, Operations Center, and guideways.
- Relevant operational utility policies and strategies listed in the adopted City of Seattle Comprehensive Plan, Utilities Element (level of service, conservation strategies, and coordination of service providers).

See Section 4.17.10.2 for a discussion of construction impact mitigation on Utilities.

4.9.4 Significant Unavoidable Adverse Impacts

The mitigation measures described above are expected to address any impacts on public services and utilities that could occur as a result of operation of the Green Line. Therefore, no significant unavoidable adverse impacts are expected.

4.10 PARKS AND RECREATION

4.10.1 Affected Environment

Seattle's parks and recreation system consists of open spaces, parks, boulevards, trails, beaches, lakes, and streams; recreational, cultural, environmental, and educational facilities; and a broad variety of programs. The diverse system is woven into the fabric of Seattle neighborhoods and contributes to the city's identity, stability, urban design, and network of public services. Citywide, the Seattle Parks and Recreation Department administers 400 parks and open space areas covering approximately 6,200 acres.

Although public park land may be used in this project, a Section 4 (f) analysis was not conducted because the regulations no longer apply to the Coast Guard. The Homeland Security Act of 2002 transferred the U. S. Coast Guard from the U. S. Department of Transportation (DOT) to the U. S. Department of Homeland Security (DHS). Prior to passage of the Homeland Security Act, the Coast Guard's bridge permit program had been a DOT program. As a DOT agency, the Coast Guard was responsible for implementing Section 4(f) of the DOT Act of 1966. The 1966 DOT Act requires DOT agencies to perform a particular type of alternatives analysis for transportation projects that use any land from a public park, recreation area, wildlife and waterfowl refuge, or any historic site. Since the Coast Guard is no longer a DOT agency, a Section 4(f) analysis is not required for Coast Guard bridge permit actions. The Coast Guard will, nevertheless, ensure project environmental impacts on these resources are identified and assessed in the EIS, and appropriately considered before any final agency action on the project is taken.

There are twenty existing and twelve planned parks and recreational facilities that are under the jurisdiction of City of Seattle Parks and Recreation Department and are within 600 feet of Green Line guideway alignment, station, and Operations Center alternatives (Seattle Parks and Recreation Department 2002). Tables 4.10-1 and 4.10-2 list existing and planned park and recreational resources, respectively, identified within the proximity of the Green Line project area. Existing parks are discussed in more detail in the following sections. The Seattle Center is not a City of Seattle park property and therefore it is not listed in these tables. Figure 4.10-1 shows the existing park and recreational resources.

Table 4.10-1. Existing Parks and Recreational Resources Within 600 Feet of the Green Line Alignment Alternatives

Segment	Park Resource
Ballard	Baker Park on Crown Hill
	Ballard Swimming Pool
	Greg's Garden (East Ballard P-Patch)
	14 th Avenue NW Boat Ramp
Interbay/Magnolia	Interbay Athletic Complex
	Interbay P-Patch
	Southwest Queen Anne Greenbelt
	Kinnear Park
Queen Anne/Seattle Center/Belltown*	Tilikum Place
Downtown/Pioneer Square	Westlake Park
	Pioneer Square Park
	Occidental Square
SODO/Chinatown ID/Pioneer Square	Union Station Square

Table 4.10-1. Existing Parks and Recreational Resources Within 600 Feet of the Green Line Alignment Alternatives(continued)

West Seattle	West Duwamish and Pigeon Point Greenbelt Longfellow Creek Greenspace Delridge Playfield West Seattle Stadium Park West Seattle Golf Course Camp Long Fauntleroy Place Eddy Street Ravine
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* Seattle Center is not a City of Seattle Parks and Recreation Department park, so it is not included in this list.

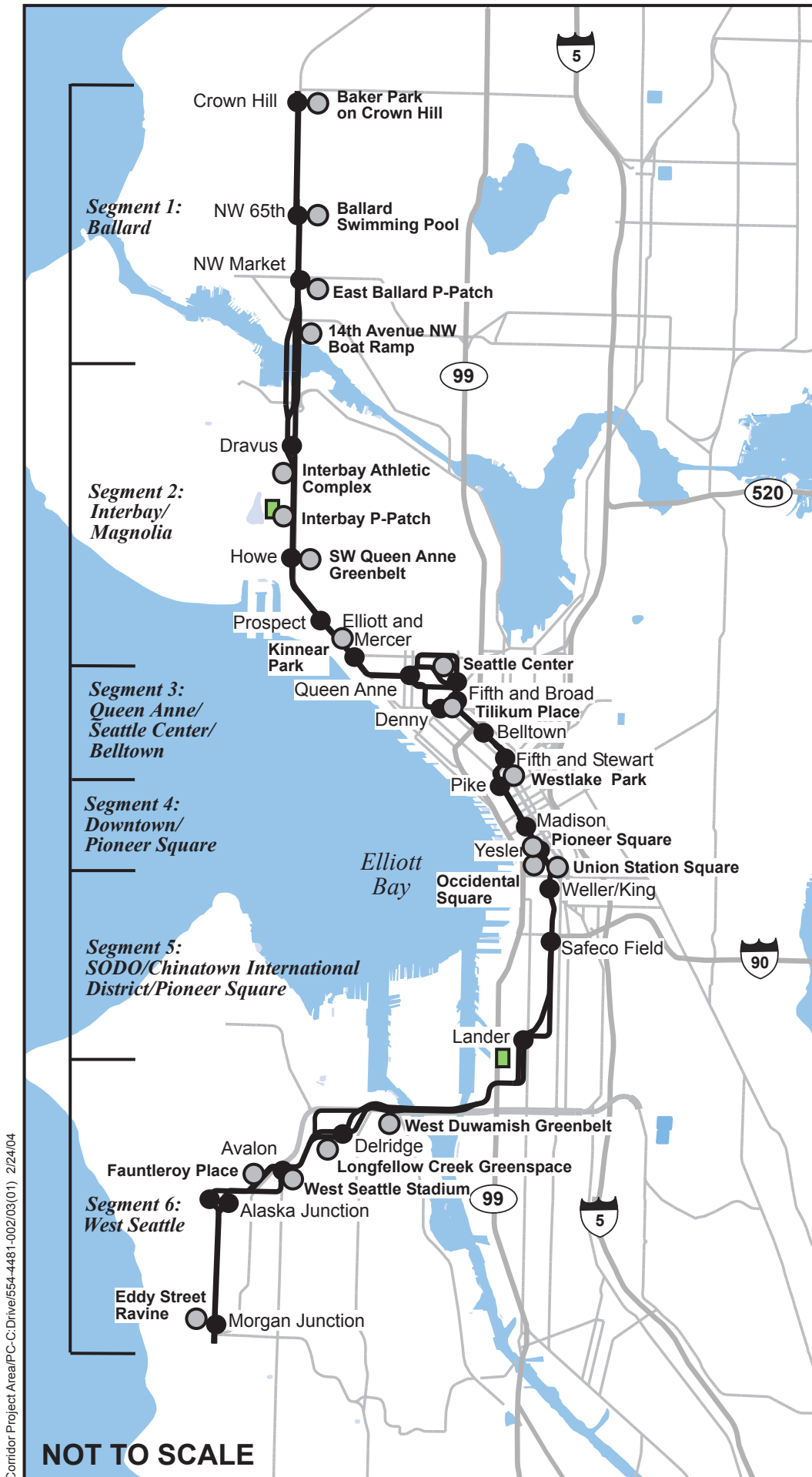
Source: *Seattle Park Guide*, Seattle Parks and Recreation (2001).

Table 4.10-2. Major Park Projects Planned Near the Green Line Alignment Alternatives

Segment	Planned Park Project	Implementation Status
Ballard	Development of the Ballard Municipal Center park at 5701 22 nd Avenue NW in conjunction with the proposed Ballard Municipal Center development	Planning is scheduled in 2005–2008 funding cycle
	Development of Monroe Substation site at NW 65 th Street and 15 th Avenue NW into a small park, possibly a community garden	Seattle Parks expect to purchase property from Seattle City Light in 2004
	Extension of the Burke-Gilman Trail (the missing link) from Fremont through an alignment south of NW Market Street	Section from the Ballard Locks to NW 60 th Street is scheduled for construction in 2003; design study has been completed for the “missing link” segment between 11 th Avenue NW and the Ballard Locks
	Recently purchased pocket park site at southwest corner of NW 63 rd Street and 17 th Avenue NW	Property was purchased by Seattle Parks on March 17, 2003 and planning is underway
Interbay/Magnolia	No new parks are planned for the Interbay Segment at this time	
Queen Anne/ Seattle Center/ Belltown	Development of Belltown/Uptown waterfront connections to Myrtle Edwards Park	No schedule information is available
	Development of Ward Springs Park (Fourth Avenue N and Ward Street)	Park opened on June 1, 2002
Downtown/Pioneer Square	No new parks are planned for the Downtown Segment at this time	
SODO/Chinatown ID/Pioneer Square	No new parks are planned for the SODO Segment at this time	
West Seattle	Purchase of surplus utility property (California Substation) for park	Planning process scheduled to begin in September 2003
	Acquisition of Seattle City Light’s Morgan Substation on Fauntleroy Way to develop a small park/plaza	Planning is scheduled in 2005–2008 funding cycle
	Purchase of land along Longfellow Creek and Puget Ridge for Delridge open space	Funding is available to build or improve trail segments in 2003–2004
	Walking trail development along Longfellow Creek Legacy Trail	Project ongoing, no schedule information is available
	Link between Alki Trail and Spokane Street Trail	No schedule information is available
	Planned “Junction Square” plaza on northwest corner of SW Alaska and 42 nd Avenue SW	No schedule information is available

Source: ETC (2002).

Figure 4.10-1
Locations of Parks,
Recreational Resources,
and P-Patches along the
Green Line Corridor



4.10.1.1 Segment 1: Ballard Segment

The Ballard Segment has four existing and four planned parks (Table 4.10-2) and recreational resources within 600 feet of the Green Line alignment alternatives. Existing parks and recreational resources include:

- **Baker Park on Crown Hill.** This 0.4-acre park includes a small play area, a pedestrian path, and a totem pole made from a monkey-puzzle tree. Baker Park spans the block between Mary Avenue NW and 14th Avenue NW, one lot south of NW 85th Street. Adjacent uses include residences and commercial properties.
- **Ballard Swimming Pool.** This is an indoor facility open for public use throughout the week. The pool is located on the east side of 15th Avenue NW immediately south of NW 67th Street and north of Ballard High School. There are tennis courts located at the site as well.
- **Greg's Garden.** This was formerly known as the East Ballard P-Patch. It covers 5,000 square feet is located on the southwest corner of 14th Avenue NW and NW 54th Street.
- **14th Avenue NW Boat Ramp.** The 0.64-acre boat ramp is located on the Lake Washington Ship Canal at the intersection of 14th Avenue NW and Shilshole Avenue NW, east of the Ballard Bridge. The site is one of Seattle's free-of-charge boat launch ramps, offering two piers and two launch lanes. The boat ramp was renovated in 1996, adding a new dock, a resurfaced ramp, and improved parking. The upland improvements include two handicap parking stalls and an accessible portable restroom.

4.10.1.2 Segment 2: Interbay/Magnolia Segment

The Interbay Segment has four existing parks and recreational resources within 600 feet of the Green Line alternative alignments. Existing parks and recreational resources include:

- **Interbay Athletic Complex.** The Interbay Athletic Complex includes the Soccer Center, the 39-acre, nine-hole Interbay Golf Center, and Little League baseball, softball, and T-ball facilities. It is west of 15th Avenue W between W Dravus and W Wheeler Streets.
- **Interbay P-Patch.** The 1.91-acre P-Patch is a year-round, community-operated garden located at the southeast end of the Interbay Athletic Complex, on 15th Avenue W just north of W Wheeler Street.
- **Southwest Queen Anne Greenbelt and Kinnear Park.** The approximately 15-acre Southwest Queen Anne Greenbelt and the two-tiered 14-acre Kinnear Park are located on the southwest slope of Queen Anne Hill above 15th Avenue W and Elliott Avenue W. The parks offer views of Elliott Bay and Downtown Seattle, walking paths, and wooded areas and grassy areas for sitting.

4.10.1.3 Segment 3: Queen Anne/Seattle Center/Belltown Segment

This segment has one existing park and two planned park improvements (Table 4.10-2) within 600 feet of the Green Line alternative alignments. The existing park is:

- **Tilikum Place.** This 0.1-acre park is located in Belltown at the "five points" intersection of Fifth Avenue, Denny Way, and Cedar Street, immediately west of the existing monorail. The park has the life-size statue of Chief Seattle made by James Wehn in 1912.

Seattle Center is a 74-acre recreational and cultural facility located between lower Queen Anne and Belltown. It is an important recreational and cultural resource for the city. However, since Seattle Center

is not a City of Seattle park, it is not discussed in this chapter, but, instead, is discussed extensively in Section 4.3, Land Use and Neighborhoods, and Section 4.5, Visual Quality and Aesthetic Resources.

4.10.1.4 Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment contains three existing parks within 600 feet of the Green Line alternative alignments. There are no planned park projects.

- **Westlake Park.** Westlake Park is located in the heart of Seattle's retail district on Pike Street between Fourth and Fifth Avenues.
- **Pioneer Square Park.** Pioneer Square Park is located at First Avenue and Yesler Way in the Pioneer Square Historic District and contains the Pioneer Square Pergola.
- **Occidental Square.** Occidental Square is located at Occidental Avenue S and S Main Street in the heart of Pioneer Square and contains the Firefighter's Memorial.

The Garden of Remembrance at Benaroya Hall is not a city park, but is a public resource. It is discussed in Section 4.5, Visual Quality and Aesthetic Resources.

4.10.1.5 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The SODO Segment has one existing park resource. No park projects are planned for this area. Safeco Field and Seahawks Stadium are spectator sport recreation facilities that would be served by the Green Line, and are noted as such in Section 4.3, Land Use and Neighborhoods.

- **Union Station Square.** This triangular property is in the Pioneer Square District at S Jackson Street between Second and Third Avenues S. The park does not have active uses.

There are also two public parks on the Green Line that are under the Seattle Department of Transportation's jurisdiction: Fortson Square on the southeast corner of Yesler Way and Second Avenue S, and Washington Square on the southwest corner of S Jackson Street and Second Avenue Extension S.

4.10.1.6 Segment 6: West Seattle Segment

The West Seattle Segment has six existing parks, one city-owned open space area (Eddy Street Ravine), and six planned park improvements (Table 4.10-2) within 200 feet of the Green Line project area. Existing parks and recreational resources include:

- **West Duwamish and Pigeon Point Greenbelt.** A portion of the 181.6-acre West Duwamish Greenbelt is located within the West Seattle Segment and includes a steep slope area at Pigeon Point. The greenbelt is owned by the City of Seattle and is composed of steep, wooded slopes above the West Seattle Bridge and the east-facing slopes above W Marginal Way and the Duwamish River.
- **Longfellow Creek Greenspace.** Longfellow Creek originates in Roxhill Park to the south and flows north about four miles parallel to the Delridge Way SW corridor. The creek enters a pipe at SW Andover Street that carries the stream under the Nucor Steel property and discharges into the West Duwamish Waterway to the northeast. The Longfellow Creek watershed is approximately 2,685 acres, and the Longfellow Creek Greenspace is managed so as to preserve and protect the stream. The greenspace is largely undeveloped, although there are footpaths used by the public, including residents in the neighborhood. There has been a community effort to improve the stream for fish habitat for several years, including yearly fish releases conducted by local schools. A Longfellow Creek Dragonfly Pavilion is planned to be located adjacent to 28th Avenue SW

near SW Dakota Street in the upland area of the Longfellow Creek Greenspace. The plant and animal environment of Longfellow Creek is described in more detail in Section 4.15, Plants and Animals.

- **Delridge Playfield.** The 14-acre playfield contains grass picnic and play areas, tennis courts, a wading pool, a soccer field, and baseball fields. The Delridge Community Center is part of the park and offers a wide variety of classes and programs for all ages groups.
- **West Seattle Stadium Park.** This park has football and soccer fields and facilities for field sports (such as long jump, pole vault, shot put, and others), including a 400-meter track. The fields are used for youth, masters, and high school meets. Also on the site is a parking lot that serves the Stadium and the Golf Course.
- **West Seattle Golf Course.** This is a public 18-hole golf course.
- **Camp Long.** This 68-acre park has a nature center with meeting and recreational facilities for environmental education, forested trails and paths for hiking, cabins and picnic shelters, a climbing rock, and a pond.
- **Fauntleroy Place.** Fauntleroy Place is a triangular landscaped area (0.07-acre) at the junction of Fauntleroy Way SW, 38th Avenue SW, and SW Oregon Street. It is used primarily as a bus stop waiting area.
- **Eddy Street Ravine.** Eddy Street Ravine is a public street right-of-way and City-owned open space located west of California Avenue SW to 47th Avenue SW along the curve of SW Eddy Street. This ravine is one of the largest unimproved open spaces in the Morgan Junction area, with opportunities for trails, native habitat restoration, and interpretive signing.

4.10.2 Impacts

4.10.2.1 Long-Term Impacts

Direct long-term impacts from the Green Line could include view blockage, shadows, and access restrictions where parks or recreational resources are located adjacent to the monorail guideway or a station. Increased traffic or transit activity near a park or recreational resource could also cause changes in access, shadows, and views from parks. Shadow and view impacts are also discussed in Section 4.5, Visual Quality and Aesthetic Resources. Increased noise is not expected to be high, unless otherwise specified in the discussion below, due to the urban setting.

Operation of the Green Line could improve access to parks and recreational resources, especially for those who live or work within walking distance of a monorail station, which could increase park usage without increasing parking demand.

Potential long-term impacts on parks and recreational resources in each segment of the Green Line are discussed below.

Segment 1: Ballard Segment

Green Line station and alignment alternatives are expected to have low impacts on parks along the alignment in Ballard.

- **Baker Park on Crown Hill.** Views of the Green Line station and guideway Alternatives 1.1, 1.1(s), and 1.2 would be blocked by the Crown Hill Safeway at NW 85th Street and 15th Avenue NW. Project impacts to this park are expected to be low for all alignments and station alternatives.

- **Ballard Swimming Pool.** The NW 65th 2 (Center) station and Alternative 1.2 would have a moderate to high impact on the Ballard Swimming Pool because of the platform and access stairs on the east side of 15th Avenue NW, directly adjacent to the pool building. Impacts would include a change in visual character and possible removal of street trees. Shadow impacts on the building and parking lot would be low since the corner and west side of the building are now shaded by medium to very large trees. Access to the pool and the planned park at the Monroe Substation site could improve with the addition of the Green Line, which could increase use of the pool. Alternatives 1.1 and 1.1(s) and station alternatives NW 65th 1 (West), 1A (West), and 1B (West) would have no direct impact on the pool because they all would be located south of NW 65th Street. With any of these alternatives, there would be potential parking impacts. These would be expected to be greater with NW 65th 2 because of its close proximity. Impacts due to the Preferred Alternative are expected to be identical to Alternative 1.1(s).
- **Greg's Garden and 14th Avenue NW Boat Ramp.** Operational impacts on Greg's Garden and the 14th Avenue NW Boat Ramp are expected to be low to nonexistent for all three Ship Canal bridge alternatives (1.2, 1.1.1, 1.1.1(s), and 1.1.2) because the alternatives would be approximately 600, 1,000, 1,000, and 1,800 feet away from the 14th Avenue NW Boat Ramp, respectively, and 600 feet from Greg's Garden. Impacts on the planned extension of the Burke-Gilman Trail due to any of the alignment or station alternatives are expected to be low because the trail would be passing through an industrial corridor in this area.

Segment 2: Interbay/Magnolia Segment

Green Line station and alignment alternatives are expected to have low to moderate impacts on parks along the alignments in Interbay. Alignment Alternative 2.2, traveling along the west side of Elliott Avenue W, would be adjacent to the perimeter of the Interbay Athletic Complex and Interbay P-Patch. Golf course and P-Patch users in particular could experience changes to the visual or aesthetic setting and altered access due to the location of the guideway and columns. Alignment Alternatives 2.1 and 2.1(s) are expected to have less impact than Alternative 2.2 because Alternative 2.1 or 2.1(s) would be in the center of Elliott Avenue W, an additional 50 feet farther away. Access to these park and recreational areas may improve due to the increased transit service frequency with any of the alternatives, which may increase use of these park resources. Alternative 2.1(s) with a single beam configuration would result in somewhat reduced visual and shadow impacts.

The Preferred Alternative for Interbay (Alternative 2.1, on the west side of 15th and center of Elliott with the Interbay Operations Center alternative) would be the same as those described above for Alternative 2.1 and below for the Interbay Operations Center.

The Interbay Operations Center alternative is located on the Northwest Center site, immediately south of the Interbay P-Patch. Long-term noise, traffic, or visual impacts associated with this Operations Center alternative are expected to be low given the low-intensity nature of the uses and low number of personnel required at the Operations Center. There would be no operational impacts on the Southwest Queen Anne Greenbelt and Kinnear Park because of their locations above and east of 15th Avenue W.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Impacts on Tilikum Place under Alternatives 3.1, 3.3, or 3.5 would be lower than impacts associated with the No Action Alternative because of newer and quieter trains compared to the existing monorail. Green Line columns and guideway would also be less bulky and therefore less of a presence than the existing monorail. An increase in visual obstruction could be expected from Alternative 3.2 (Mercer) if the existing Seattle Center Monorail remains along with the Green Line. Impacts to Seattle Center are

discussed in Section 4.3, Land Use and Neighborhoods, and Section 4.5, Visual Quality and Aesthetic Resources. There would be no impacts on the planned parks.

Segment 4: Downtown/Pioneer Square Segment

Green Line alternatives are expected to have no or low impact on the Downtown parks.

- **Westlake Park.** The monorail guideway and stations at Stewart Street would not be visible from Westlake Park. If an elevated pedestrian connection from the Stewart station to Westlake Center is constructed, access to the park could be enhanced. The Fifth and Stewart 1 (Northwest) and 1A (West) station alternatives could provide slightly greater accessibility to Westlake Park than the Fifth and Stewart 2 (Virginia), 2A (Virginia Center), or Fifth and Stewart 3 (Lenora) stations, but otherwise the relationship of the park to the station alternatives would be similar.
- **Pioneer Square Park.** No direct impacts are anticipated, although the park could experience moderate vicinity impact. The alignment and Yesler station alternatives would be visible from Pioneer Square Park; however, Pioneer Square Park is a half block from the Yesler station alternatives. Traffic, noise, and activity levels in this park are not expected to increase significantly. Removal of the adjacent Sinking Ship parking garage and the development of a station facility on the site could enhance the park's surroundings and access to the park. Changes to the historic character of the area are discussed in more detail in Section 4.11, Cultural Resources.
- **Occidental Square.** The alternative alignments and stations at Yesler Way and S Weller Streets would be visible from the north half of the park. Traffic, noise, and activity levels in this park are not expected to increase significantly.

The Garden of Remembrance at Benaroya Hall is not a public park, but is a culturally important space. It would experience increased afternoon shading from Alternatives 4.2 (East Side of Second with Crossover) and 4.4 (East of Center of Second with Crossover). These two alternatives, more than 4.1 (West Side of Second) or 4.3 (Center of Second), would also alter the spatial quality of the memorial space by virtue of the overhead guideways. Inside the Garden, trees would screen the guideways. Noise levels would not increase noticeably above the ambient traffic levels.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

All of the alignment alternatives would be adjacent to Union Station Square and would introduce a new visual element to the park's surroundings. The guideways could cause some shadows and view blockages; however, overall noise and visual impacts are expected to be low since the park is currently surrounded by transportation uses.

Impacts to Fortson Square and Washington Square could result from a change in visual character and an increase in shading.

Segment 6: West Seattle Segment

Impacts to the parks in the West Seattle Segment would vary depending on the specific alignment alternative chosen. Impacts to most parks would be low to moderate; however, the Avalon 2A (35th) station alternative would be partially sited on park property, resulting in a high impact.

- **West Duwamish and Pigeon Point Greenbelt.** Impacts to the greenbelt would result from alignment Alternative 6.1.2 or 6.1.2(s) (to Pigeon Point) due to the placement of piers and other structural supports on steep slopes within Pigeon Point. Trees and other vegetation would likely

have to be removed or trimmed to keep the canopies away from the guideways. A discussion of the potential impacts to vegetation and habitat is provided in Section 4.15, Plants and Animals. There could be a low to moderate increase in shading under the guideways, depending on the slope and existing tree heights at specific locations.

The Preferred Alternative would have the lowest impacts because the alignment would continue along the West Seattle Bridge past Pigeon Point.

- **Longfellow Creek Greenspace.** Operation of several of the Green Line station and guideway alternatives would introduce additional visual elements for users of the Longfellow Creek Greenspace. Three Delridge station alternatives are located at the north end of the Longfellow Creek Greenspace, where the creek enters a culvert to pass under the Nucor Steel plant. . Station alternatives Delridge 1 (26th)/Alternative 6.1 and Delridge 2 (Andover)/Alternative 6.2, and alignment Alternative 6.1 (West Seattle I) could have columns in the buffer and culvert inflow area. Impacts for both station alternatives would include shading of the northeast corner of the buffer and could involve the removal of riparian vegetation and a few trees. Impacts could be higher for Delridge 1 (26th) if the property to the south of the station and SW Yancy Street is developed as a bus layover facility. The Delridge 1A (26th) station (Alternative 6.4) would have the lowest visual impacts of the three because the station would be located entirely in the parking lot east of the creek and the guideways would be well above the culvert at the north end of the buffer. The station would cast morning shadows on the buffer area. Diffuse shadows from the guideways would fall on SW Andover Way most of the year, except during the height of summer, when they could fall on part of the buffer.

These station alternatives would also be near the possible future Dragonfly Pavilion, to be located near the curvilinear concrete retaining walls to the southwest. Views of the station and guideways from the interior of the park and the future Pavilion, if built, would be partially blocked by the buildings at the southeast corner of SW Yancy Street and 28th Avenue SW and by cottonwoods along SW Yancy Street. However, these additions to the park's surroundings may be perceived as negative impacts by park users. Other impacts that may be perceptible to park users are increased traffic or transit activity, and increased noise from buses and monorail trains.

Alternative 6.5 (Genesee) would travel along the south side of SW Genesee Street. Longfellow Creek passes under SW Genesee Street at the northeast corner of the West Seattle Golf Course. As with Alternative 6.4, the guideways would be aligned over the street so shadow impacts would be low. The creek on the south side of SW Genesee Street would not be shaded, however the creek and greenspace on the north side would receive diffuse shading from autumn through spring.

Alternative 6.4(s), a single beam configuration that would not include a Delridge station, would have lower impacts to the greenspace because there would be no station or associated bus layover space and because the single beam guideway configuration would cast narrower shadows.

Alternative 6.3(s) (Delridge North) and associated station Delridge 3 (Nucor) would be located on the north side of the steel plant and would not impact the greenspace.

The Preferred Alternative would not affect Longfellow Creek Greenspace because the alignment would travel north of the Nucor plant and use the Delridge 3 (Nucor) station alternative.

- **Delridge Playfield.** Alternative 6.5 (Genesee) subsegment would travel along the north side of the community center and playfield park. This would probably require the replacement of the street trees just south of the sidewalk on the south side of SW Genesee Street and would change the spatial quality of and views from the north end. The guideways would be quite high above

the street and would not block any views north to the neighborhood, and would remain in the street right-of-way outside park property.

The Preferred Alternative 6.3 (s) would not affect the playfields because the alignment would travel north of the Nucor plant.

- **West Seattle Stadium Park.** Alternative 6.2.1 would travel along the east side of 35th Avenue SW adjacent to the park. The Avalon 2A (35th) station alternative used by Alternative 6.2.1 would be located on park property, on the sloped, wooded area that is currently a mature tree buffer on the west side of a sports field (see Section 4.2, Displacements and Relocation). Impacts due to this station alternative would be high because most of the trees at the north end of the wooded buffer would be permanently removed (Figure M-101) and park property would be lost (please refer to Section 4.10.3, Mitigation, for a discussion of replacement property). This would affect views from and to the stadium site since the wooded hillside provides a backdrop to the field events inside the stadium.

The Preferred Alternative 6.2.2 would have much lower impacts because it would not require park property. The Avalon 2B (35th) station would be on the west side of 35th Avenue SW; therefore there would be no impact on park property or the tree buffer. The tree buffer would remain and would screen views of the station and guideways from within the park. Selection of either the 2A or 2B station alternatives may improve access to the West Seattle Stadium, especially for those who live or work within walking distance of the monorail stations. Construction impacts to access are discussed in Section 4.17.11.1, Construction.

- **West Seattle Golf Course.** Alternative 6.5 (Genesee) would travel along the north side of the golf course, but impacts to the golf course would be low. The guideways are high enough to not block views to the north, and no shadows would fall on the golf course. Golfers now look at homes and midrise apartment buildings to the north of the course, and this view would be altered by the presence of the guideways.
- **Camp Long.** There would be no direct impacts because none of the alternatives would pass by the park.
- **Fauntleroy Place.** Impacts to Fauntleroy Place are expected to be low since the park is located adjacent to a high-volume arterial street (Fauntleroy Way SW). Alternative 6.1.3 (Northwest Side of Fauntleroy) is expected to have less impact than Alternative 6.1.4 (Southeast Side of Fauntleroy) since the Green Line alignment would be farther away from the park across Fauntleroy Way SW. Potential impacts due to either alternative include increased traffic or transit activity, alteration of the visual or aesthetic setting, and some shadow effects. Alternative 6.2 would not affect this park since the alignment would be located on 35th Avenue SW.
- **Eddy Street Ravine.** Impacts to the Eddy Street Ravine open space are expected to be low for either Alternative 6.1 or 6.2. However, impacts would be comparatively higher for Alternative 6.1 (or 6.1.6(s)) because the Morgan Junction 1 (West) station site is located just south of the Eddy Street right-of-way. Vehicular access to a short-term parking area and a small staff parking lot would be provided from the end of the Eddy Street right-of-way with Alternative 6.1 or 6.1.6(s).

4.10.2.2 Impacts of No Action Alternative

Adverse impacts on parks and recreational resources would not occur under the No Action Alternative. Access would remain unchanged and growth in resource use would continue, although possibly at a lower rate than with the Green Line project. To the extent that stations are planned near park resources such as

the Ballard Swimming Pool, Westlake Park, and West Seattle Stadium, then enhanced access to those resources would not occur with No Action.

4.10.3 Mitigation

Visual impacts as a result of the construction of alignment Alternative 6.1.2 to Pigeon Point and any alignment to the Longfellow Creek greenspace could potentially be mitigated by replanting in those locations after construction or by providing additional plantings at another location. Some visual impact to the Pigeon Point area from the 6.1.2 alignment alternative could be unavoidable due to the permanent removal of vegetation. During construction, temporary erosion and sediment control practices would be required and implemented. Preferred Alternative 6.1.1(s) would not affect the Pigeon Point greenbelt. Preferred Alternative 6.3(s) and its associated station would not affect Longfellow Creek greenspace.

Visual impacts to parks within sight of station alternatives such as West Seattle Stadium Park (Avalon 2A and 2B), Ballard Swimming Pool (NW 65th 2), Pioneer Square Park (Yesler 1 and 2), and Longfellow Creek Greenspace (Delridge 1, 1A, and 2) could be mitigated through appropriate design of facilities, including landscaping, special signage, lighting, and access. If the Avalon 2A (35th) station for Alternative 6.2 or 6.2.1 were selected, it would be designed to incorporate specific mitigation features for the park, including planting, access improvements, and design features to ensure that use of the stadium is not compromised. If this station alternative site were developed, City of Seattle Ordinance 118477 would require SMP to replace park property with other property in the same neighborhood that provided equivalent park functions. Preferred Alternative Avalon 2B would not affect West Seattle Stadium Park.

4.10.4 Significant Unavoidable Adverse Impacts

Construction and operation of a station at Longfellow Creek Greenspace would result in changes to the visual character and vegetation of the creek buffer at this location that could be perceived as a significant unavoidable adverse impact by park users. Mitigation could provide some improvement over existing conditions, including planting and access improvements. The Preferred Alternative would not affect the greenspace.

Similarly, construction of the guideway at Pigeon Point would result in changes to the visual character and vegetation of the greenbelt that could be perceived as an adverse impact by residents near the greenbelt. Mitigation would provide some revegetation and infill planting for the greenbelt. The Preferred Alternative would not affect the greenbelt.

Construction of the Avalon 2A (35th) station would result in the removal of the existing tree buffer along the northwest side of the West Seattle Stadium Park. Park users could perceive this as a significant adverse impact. Mitigation would provide some revegetation but the physical buffer would not be replaced. However, the property would be subject to the City of Seattle Ordinance 118477 requiring replacement of park property with other property, as discussed above. The Preferred Alternative would not affect West Seattle Stadium Park.

4.11 CULTURAL RESOURCES

This section of the EIS reviews the Green Line's potential impacts on cultural resources (archaeological, ethnographic, and historic) under federal, state, and local regulations. Because the U. S. Coast Guard review for water crossings is a federal undertaking, consultation under the National Historic Preservation Act (NHPA) is applicable to that undertaking. State of Washington and City of Seattle regulations regarding cultural resources also apply to the Green Line.

This EIS has been structured to meet the requirements of NEPA, the NHPA, EPA, RCW 27.53, and the City of Seattle landmarks ordinance. There is a difference in terms used to describe the consequences of an alternative under applicable regulations. While NEPA and SEPA documents typically use the term "impact," NHPA compliance involves a determination of "effects," and an "adverse effect" is considered a significant impact.

Federal Regulations

NEPA requires consideration of the effects of an undertaking on cultural resources before an undertaking is approved. 36 CFR Part 800 allows for NEPA/Section 106 consideration. As a result, this EIS has been structured to comply with NHPA in addition to NEPA.

Section 106 of the NHPA of 1966 (as amended) requires federal agencies to assess effects of all federal undertakings (including where a federal permit is required, such as for the Green Line), as defined in 36 CFR 800.16(Y) on historic properties. The NHPA defines historic properties as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register of Historic Places" (NRHP) (36 CFR 800.16).

The NRHP is the federal list of historic, archaeological, and other cultural resources that are significant in American history, prehistory, architecture, archaeology, engineering, and culture and includes districts, sites, buildings, structures, objects, and landscapes. The list includes not just historic properties themselves, but also artifacts, records, and remains that are related to and located in such properties. Eligibility for inclusion in the NRHP is based on properties that illustrate integrity of location, design, setting, material, workmanship, feeling, and association, and that:

- are associated with events that have made a significant contribution to the broad patterns of our history; or
- are associated with the lives of persons significant in our past; or
- embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components lack individual distinction; or
- have yielded, or may be likely to yield, information important in prehistory or history.

Buildings less than 50 years old do not meet the NRHP criteria unless they are of exceptional importance.

The Homeland Security Act of 2002 transferred the U. S. Coast Guard from the U. S. Department of Transportation (DOT) to the U. S. Department of Homeland Security (DHS). Prior to passage of the Homeland Security Act, the Coast Guard's bridge permit program had been a DOT program. As a DOT agency, the Coast Guard was responsible for implementing Section 4(f) of the DOT Act of 1966, which requires DOT agencies to perform a particular type of alternatives analysis for transportation projects that use any land from a public park, recreation area, wildlife and waterfowl refuge, or any historic site. Since the Coast Guard is no longer a DOT agency, a Section 4(f) analysis is not required for Coast Guard bridge

permit actions. The Coast Guard will, nevertheless, ensure compliance with Section 106 and ensure project environmental impacts on these resources are identified and assessed in the EIS, and appropriately considered before any final agency action on the project is taken.

Washington State Regulations

Washington's State Environmental Policy Act (RCW 43.21C) and implementing rules in the Washington Administrative Code (WAC 197-11) require the identification of significant impacts to historic, archaeological, and cultural resources listed in or eligible for the national, state, or local registers. Measures must be considered to reduce or control effects to identified historic properties affected by a proposed undertaking. In addition, Washington's Archaeological Sites and Resources law (RCW 27.53) provides for the conservation, preservation, and protection of the state's archaeological resources and prohibits individuals, corporations, and agencies from knowingly removing, altering, digging into, excavating, damaging, defacing, or destroying any historic or prehistoric archaeological site without a written permit from the Washington State Department of Community Development or other designee.

The Office of Archaeology and Historic Preservation (OAHP) in Olympia administers Washington State's cultural resources regulations and its NRHP program under the direction of the State Historic Preservation Officer (SHPO). The OAHP also administers the Washington Heritage Register, a Washington-specific list of properties similar to the NRHP.

Federal agencies (including agencies reviewing permits for federally regulated undertakings such as the Green Line project) must coordinate with the SHPO and obtain the review and comment of the Advisory Council for Historic Preservation (ACHP) before beginning undertakings that may affect properties eligible for the NRHP.

City of Seattle Regulations

In adopting the State Environmental Policy Act ordinance, the City of Seattle established environmental policies and procedures specific to historic resources (SMC 25.05). In addition, under the City's Landmarks Preservation Ordinance (SMC 25.12), an object, site, or improvement that is more than 25 years old may be designated as a landmark if it has significant character, interest, or value as part of the development, heritage, or cultural characteristics of the city, state, or nation, and if it falls into one of the following categories:

- A. It is in the location of, or is associated in a significant way with, any historic event with a significant effect upon the community, city, state, or nation; or
- B. It is associated in a significant way with the life of a person important in the history of the city, state, or nation; or
- C. It is associated in a significant way with a significant aspect of the cultural, political, or economic heritage of the community, city, state, or nation; or
- D. It embodies the distinctive visible characteristics of an architectural style, period, or of a method of construction; or
- E. It is any outstanding work of a designer or builder; or
- F. Because of prominence of spatial location, contrasts of siting, age, or scale, it is an easily identifiable visual feature of its neighborhood or the city and contributes to the distinctive quality or identity of such neighborhood or the city.

The Seattle Landmarks Preservation Board reviews and acts on nominations, designations, and applications or Certificates of Approval (required for any change of use and to alter, demolish, construct, remodel, or to make visible change to the exterior appearance) for designated features of City landmarks.

The City may require reasonable mitigation measures to permitted undertakings when a site of archaeological significance is affected by an undertaking or when a proposed undertaking adversely affects a designated City landmark. The City's Department of Construction and Land Use Director's Rule 2-98 also applies.

4.11.1 Affected Environment

4.11.1.1 Area of Potential Effects

The Green Line is a linear system that will, by necessity, cross many areas where there are cultural resources. The first consideration of the effects of a proposed undertaking on cultural resources is based on determining an Area of Potential Effects (APE). The APE includes "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist... The APE for an undertaking may be different for different kinds of effects caused by the undertaking" (36 CFR 800.16 (y)). This EIS defines the APE for the evaluation of cultural resources along the Green Line route alternatives. In addition, because of the presence of historic districts in several segments, and based on consultation with the SHPO and the City of Seattle Historic Preservation Officer, the APE for historical resources in those areas has been expanded as noted below.

Archaeological and Ethnographic Resources

The Green Line's APE for archaeological resources consists of areas of potential ground disturbance where columns, stations, and substations could be constructed. The APE includes possible historic period archaeological deposits associated with Pioneer Square Historic District areaways below the margins of Second Avenue. The archaeological deposits would be below architectural features that occur within the areaways.

Historical Resources

In the Ballard, Interbay, SODO, and West Seattle Segments, the Green Line's APE for buildings and structures over 50 years old (historical resources) includes resources adjacent to (within 100 feet of, which encompasses the width of approximately one building) the guideways and stations. These areas consist of mixed residential and commercial use areas that have in-fill development and numerous alterations to resources that are 50 years of age and older.

Within the Downtown and Queen Anne/Seattle Center/Belltown Segments, the APE was expanded to include resources within 200 feet of alternative station locations, due to the presence of historic districts and the density of unaltered historical resources. Similar to the other segments, the APE along guideways in the Downtown and Queen Anne/Seattle Center/Belltown Segments includes areas adjacent to (within 100 feet of) the guideway.

The alternative alignments being evaluated for the Green Line in the Downtown Segment pass through the east side of the Pioneer Square Historic District and within two blocks of the Pike Place Public Market Historic District.

- **Pioneer Square.** Within the Pioneer Square Historic District, the APE extends 200 feet on either side (east and west) of the guideway at the intersections of Second Avenue and Columbia Street, Cherry Street, James Street, Jefferson Street, Yesler Way, S Washington Street, S Main Street,

and S Jackson Street. Only the buildings and structures adjacent to the street in the above-listed areas are included in the APE. Some of the resources in the specified areas along Cherry Street and all of the resources along Columbia Street are outside the Pioneer Square Historic District boundaries, but are included in the APE due to their age and proximity to the District.

New construction in the Pioneer Square Historic District, including construction in rights-of-way, is subject to certificate of approval review by the Seattle Department of Neighborhoods. The guidelines utilized for this review are designed to help ensure visual compatibility of new structures.

- **Pike Place Market.** In the vicinity of the Pike Place Public Market Historic District, the APE extends from Second Avenue and Pike Street west along Pike Street and from Second Avenue and Pine Street west along Pine Street, two blocks to the boundaries of the historic district. The APE is expanded in this area to include assessment of visual effects to the Pike Place Public Market Historic District.

Green Line guideway and columns will be constructed primarily within the public right-of-way, with stations and other facilities located on nearby property. The APE for historical resources reflects the potential for direct and indirect effects to historic resources, either by direct alteration or removal of a historic structure, placement of a modern structure in close proximity to historical resources (Figure 4.11-1), or changing other significant elements of their setting.

4.11.2 Methodology

Archaeological and Ethnographic Resources. Archaeological and traditional cultural places were assessed through archival review, archaeological field reconnaissance of a portion of the Pioneer Square Historic District, and consultation with the Duwamish Tribe, the Muckleshoot Indian Tribe, the Suquamish Tribe, and the Tulalip Tribe. Letters of correspondence with the tribes are included in Appendix NN, the Section 106 Cultural Resources Report, which is located in Volume Three of this Final EIS. An archaeological survey of areaways beneath Second Avenue within the Pioneer Square Historic District was conducted to determine if intact archaeological deposits occurred in the lowest story of pre-1889 buildings, several feet beneath contemporary sidewalks. The Sinking Ship Areaway Site (45KI685), a historic period archaeological site, was recorded on the south side of Second Avenue in the Downtown Segment adjacent to proposed Green Line alignment alternatives.

Historical Resources. SMP identified significant buildings and structures within the Green Line APE that are 50 years of age (resources). In accordance with Seattle's SEPA rules, the significance of noteworthy resources over 25 years of age was also reviewed. Resources were recorded under the following categories:

- | | |
|-------------------|--|
| Category A | Significant resources (previously listed in the NRHP, Washington Heritage Register, Seattle Landmarks, or determined eligible for listing in the NRHP). |
| Category B | Unaltered resources within the APE that that were further researched to determine historical significance. |
| Category C | Modified resources lacking historical integrity, or historical resources from the later period without important historical or architectural associations. |

The evaluation of the resources for eligibility in the NRHP, Washington Heritage Register, or Seattle City Landmarks Register within the Green Line's APE was performed in consultation with the Washington SHPO and the Seattle Historic Preservation Officer and included a review of field evaluations and research for every resource. The review of Seattle Landmarks and Washington Heritage Register eligibility was conducted only for historical resources that would potentially be demolished. Concurrence

was reached with the agencies regarding all determinations of eligibility. Records of the coordination effort and additional methodology are included in the Section 106 Cultural Resources Report (Appendix NN). Project historians obtained information regarding resources within the APE from the Washington State Archives - Puget Sound Regional Branch, Seattle Public Library, Washington Office of Archaeology and Historic Preservation, Seattle Department of Neighborhoods Urban Conservation Division, Seattle Department of Construction and Land Use, and King County Assessor's records.

To facilitate their evaluation, the project historians undertook the following tasks:

- **Visual simulations.** Project historians worked with the SMP visual resources team to identify specific locations within the APE where visual simulations could be used to assist in addressing effects to known historic resources. The SHPO and City of Seattle Historic Preservation Officer were also consulted to obtain input regarding the refinement of specific visual simulations. Draft simulations were provided to the agencies for review. A final copy of visual simulations relevant to known historic resources is included as an appendix to the Section 106 Cultural Resources Report (Appendix NN).
- **Video and photographic survey.** The research effort also included a videotaped survey of the Green Line APE and photographs of known historic resources and their settings. The photographs were used for the visual simulations described above to assist in addressing effects to known historic resources.
- **Context statement.** A context statement that provides background information on the neighborhood development within the Green Line APE is provided in the Section 106 Cultural Resources Report (Appendix NN).
- **Field review.** The project historians evaluated 724 resources in the APE. Buildings or structures of potential significance that would be demolished (Category B) were further assessed to determine eligibility for the NRHP, Washington Heritage Register, or listing as a Seattle Landmark. Category B properties, along with previously known (Category A) historic resources, are listed and mapped in the Section 106 Cultural Resources Report (Appendix NN) by project segment. Inventory forms for Category B properties are referenced in Appendix NN and available on the OAHP database.

Agency coordination included correspondence and work sessions with the OAHP regarding NEPA and Section 106 requirements; obtaining concurrence of the SHPO and the Seattle Historic Preservation Officer on the definition of the Green Line APE; and coordinating with the City of Seattle regarding compliance with SEPA and pertinent Seattle historic preservation laws. Staff provided OAHP and the City of Seattle Urban Conservation Division with statements of the NRHP significance for resources that were over 50 years of age and located within the APE. Project staff assessed potential effects to historic resources and prepared potential mitigation measures for resources listed in or determined eligible for historic registers. To meet SEPA and City of Seattle historic preservation requirements, staff provided the City Preservation Officer with background information and a current photograph for all buildings that are proposed for demolition under the Green Line alternatives. Staff also supplied the Urban Conservation Division with an assessment of project effects and mitigation measures for Seattle Landmarks.

Numerous agency work sessions were held with the SHPO and the City Historic Preservation Officer to determine the eligibility, impacts, and mitigation measures for all historic resources in the APE of the Green Line. Below is a list of some of the meeting and agency work session dates and meeting subjects. There were over 30 public meetings held for the project. For information on public meetings, see Appendix D, Public Involvement.

- May 16, 2003: Discussed the eligibility of historical resources in SODO and West Seattle, as well as written comments provided by OAHP and the City of Seattle regarding the historic resource information packets submitted by ENTRIX for SODO, West Seattle, and Ballard.
- May 21, 2003: Discussed the eligibility of and impacts to historical resources in SODO and West Seattle.
- May 23, 2003: Discussed the eligibility of and impacts to historical resources in Ballard.
- May 28, 2003: Discussed the eligibility, impacts, and mitigation measures for historical resources in Seattle Center and Downtown.
- June 4, 2003: Discussed the additional research requested by Allyson Brooks (OAHP) on selected resources in all segments and mitigation for all segments.
- December 9, 2003: Discussed proposed mitigation measures with SHPO, City of Seattle, and Historic Seattle Preservation and Development Authority and other interested parties
- January 21, 2004: Meeting with a representative of the Advisory Council on Historic Preservation, SHPO, City of Seattle, Historic Seattle Preservation and Development Authority and other interested parties to discuss mitigation measures.

Since the publication of the Green Line Draft EIS in response to comments from the public agencies, several alternatives not studied in detail in the Draft EIS and several refined station locations have been added for detailed review in this Final EIS. This resulted in additional field investigations of 45 additional buildings. In the new study areas, architectural historians conducted field investigations to identify resources that appeared eligible for the NRHP. Preliminary recommendations regarding the NRHP eligibility of these resources have been included in the Final EIS.

Since issuing the Draft EIS, architectural historians also conducted a study of areaways outside the Pioneer Square Historic District. Areaways are the space directly beneath the sidewalk, between the building walls and the street wall. Areaways are the result of turn-of-the-century projects that raised the height of the roadways above the first floor of existing buildings. In 2003, a separate study of areaways in the Pioneer Square Historic District was conducted (Parsons Brinkerhoff and Sheridan Consulting Group 2003). The SHPO determined that Pioneer Square Historic District areaways are eligible for the NRHP. This study was incorporated in the Draft EIS (Appendix NN). Since the Draft EIS An architectural historians evaluated 34 areaways within the APE that are located outside the Pioneer Square Historic District. The study identified two properties that are eligible for the NRHP, pending concurrence from SHPO. A copy of the *Green Line Areaways Study* is included in Appendix NN.

4.11.2.1 Archaeological Resources and Traditional Cultural Places

No recorded archaeological sites or traditional cultural places eligible for listing in the NRHP are located in the Green Line APE. No significant traditional cultural places would be affected during construction or operation of the Green Line.

The probability for unknown hunter-fisher-gatherer, ethnographic period, and historic period archaeological resources varies by section of the Green Line APE. Detailed information is presented in the Section 106 Cultural Resources Report (Appendix NN). By segment, the areas include:

- **Segment 1: Ballard.** Unknown significant hunter-fisher-gatherer or ethnographic period archaeological resources may occur beneath historic fill or lacustrine sediments on the former shoreline of Salmon Bay. All station alternatives have a moderate or low probability for significant archaeological resources.

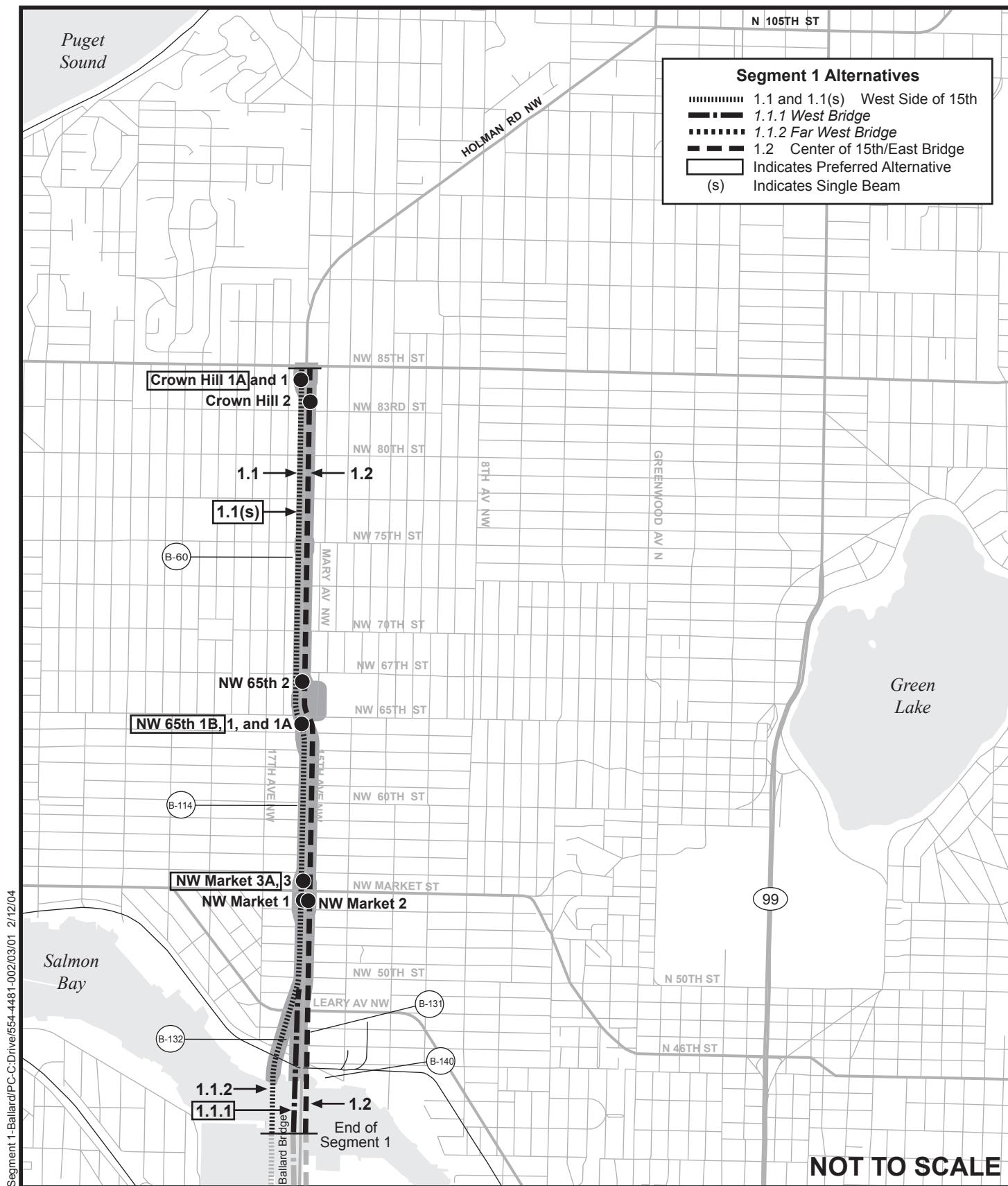
- **Segment 2: Interbay/Magnolia.** Unknown significant hunter-fisher-gatherer or ethnographic period archaeological resources may occur beneath historic fill or lacustrine sediments on the former shoreline of Salmon Bay, on the former tideflats and marsh of Smith Cove, on the former tideflats and beach of Elliott Bay, and on a low terrace at the base of bluffs fronting Elliott Bay. Historic period archaeological resources may occur on the southeast side of Smith Cove, on the former shoreline of Elliott Bay, and on a low terrace at the base of bluffs covered by contemporary Elliott Avenue W.
- **Segment 3: Queen Anne/Seattle Center/Belltown.** Alignments and stations have moderate to low probabilities for unknown significant archaeological resources except the southeast corner of Fifth and Broad near the Seattle Center, which may have unknown significant historic period archaeological resources dating between 1905 and 1917.
- **Segment 4: Downtown/Pioneer Square.** Unknown significant hunter-fisher-gatherer and ethnographic period archaeological resources may be present beneath fill in the Yesler Way and King Street vicinity. Unknown significant historic period archaeological resources may be present beneath fill in the Pike Street, Madison Street, Yesler Way, and King Street vicinities.
- **Segment 5: SODO/Chinatown International District/Pioneer Square.** Unknown significant archaeological resources may be present near King Street and on the former tideflats of Elliott Bay.
- **Segment 6: West Seattle.** Unknown significant hunter-fisher-gatherer or ethnographic period archaeological resources may occur on the former tideflats of Elliott Bay, on the north end of Pigeon Point, and in the lower reach of the Longfellow Creek drainage. There could be unknown significant early twentieth-century historic period archaeological resources near Delridge Way.

4.11.2.2 Historical Resources

Resources determined to have historical significance are identified in Figure 4.11-1 and Figures 4.11-2 through 4.11-5, which also depict the APE for project alternatives. A list of significant historic resources located within the APE is provided in Table 4.11-1. Records of the process used to determine historic significance for individual properties are also referenced in Appendix NN, in Agency Correspondence.

Segment 1: Ballard Segment

There are five historically significant resources in the Ballard Segment, including resources listed in or eligible for historic registers. The Ballard Bridge (B-140) is listed in the NRHP. Four additional buildings, including an industrial plant (B-132), a restaurant (B-131), an apartment building (B-114), and a residence (B-60), were determined eligible for inclusion in the NRHP. The background field inventory in the Ballard Segment reviewed 140 resources in the APE. This segment consists of residential, commercial, and industrial buildings, with commercial and industrial properties increasing in density to the south approaching Salmon Bay and the older part of Ballard. Nineteen of the 140 resources reviewed were Category A or B properties, which were researched further and evaluated for eligibility in historic registers.

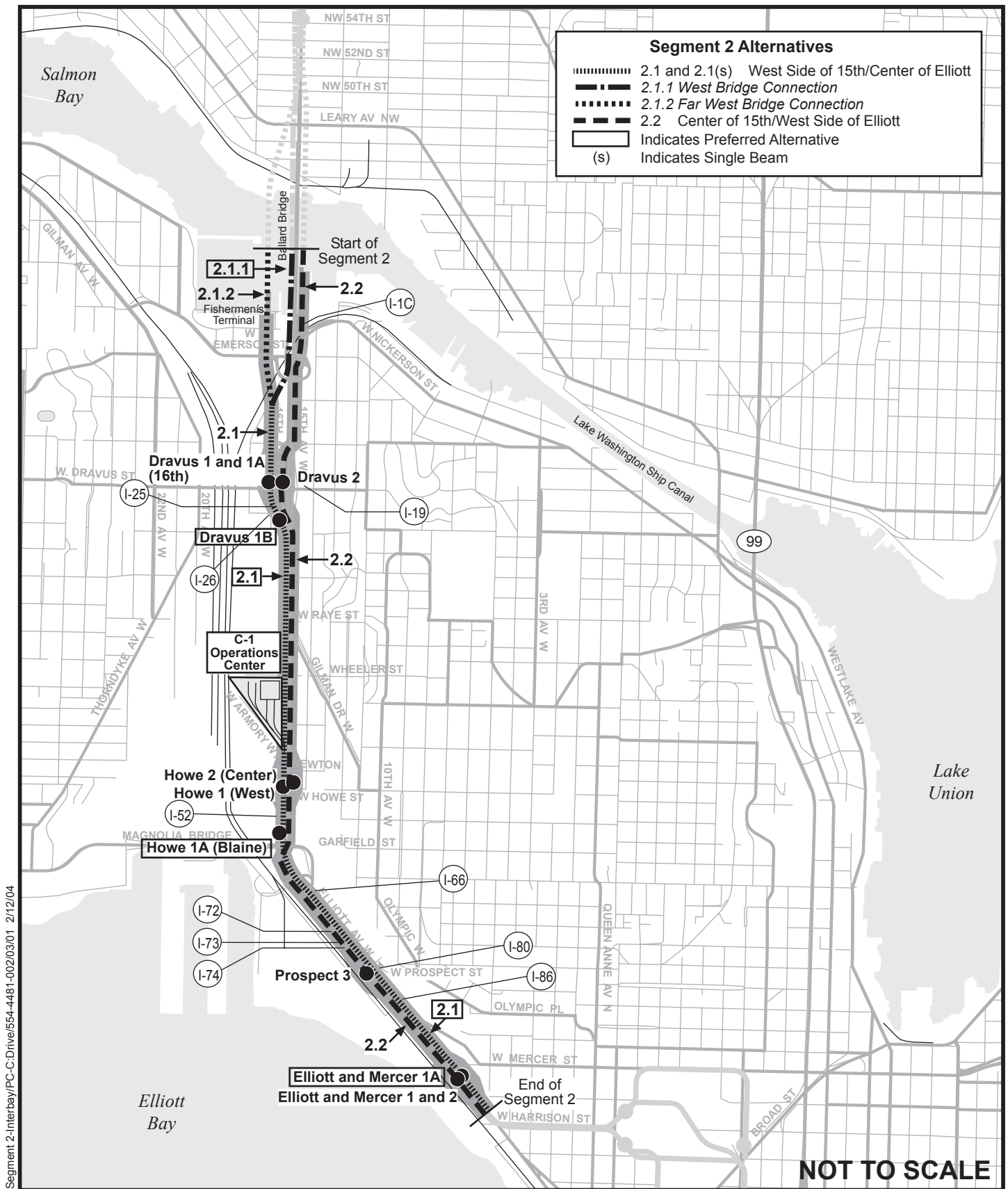


SEATTLE MONORAIL PROJECT



Area of Potential Effect (APE)
for Buildings and Structures

Figure 4.11-1
Segment 1: Ballard
Historic Resources Listed in or
Eligible for Historic Registers



Segment 2-Interbay/PC-C:Drive/654-4481-002/03/01 2/12/04



Area of Potential Effect (APE)
for Buildings and Structures

Figure 4.11-2
Segment 2: Interbay/Magnolia
Historic Resources Listed in or
Eligible for Historic Registers

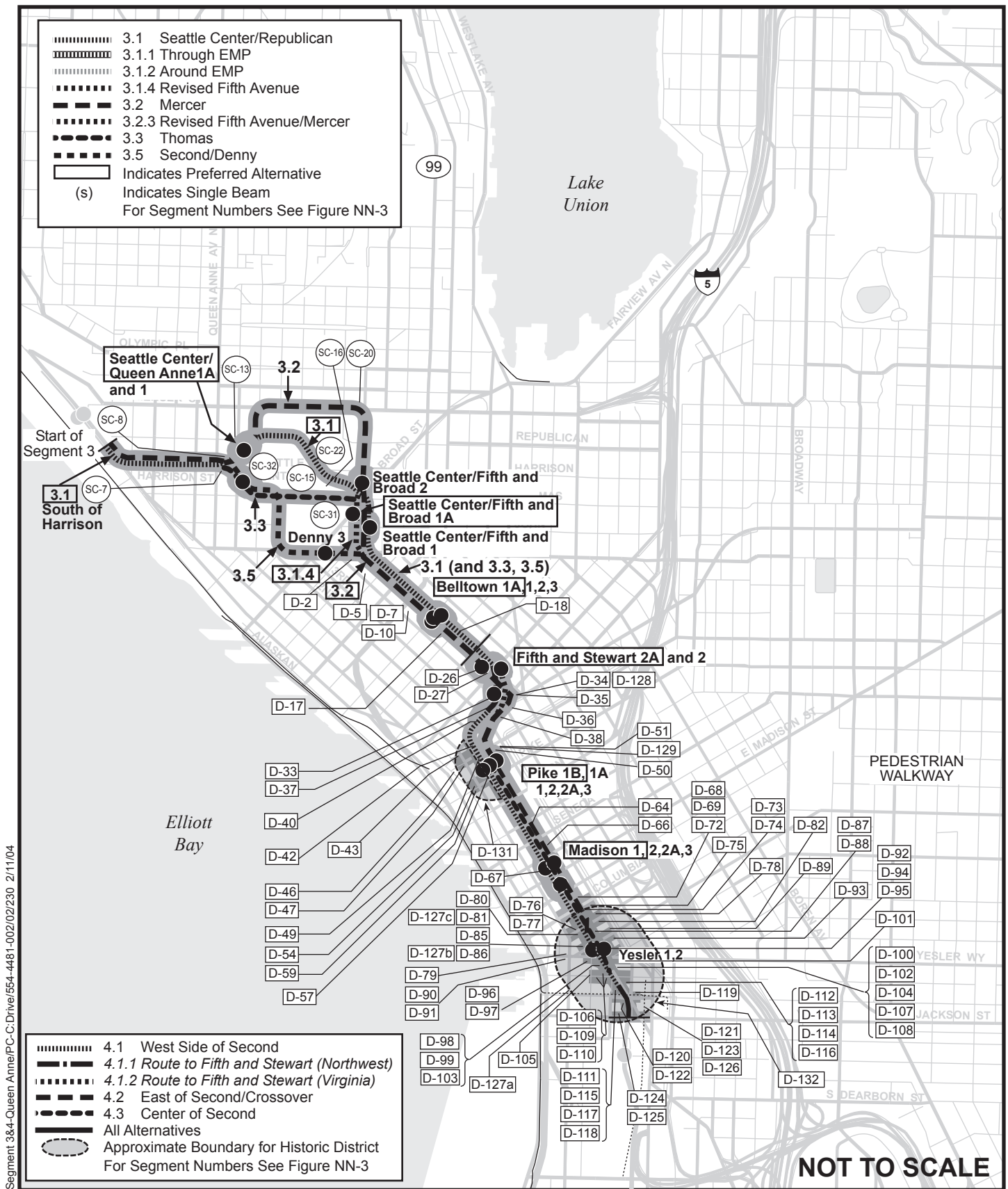
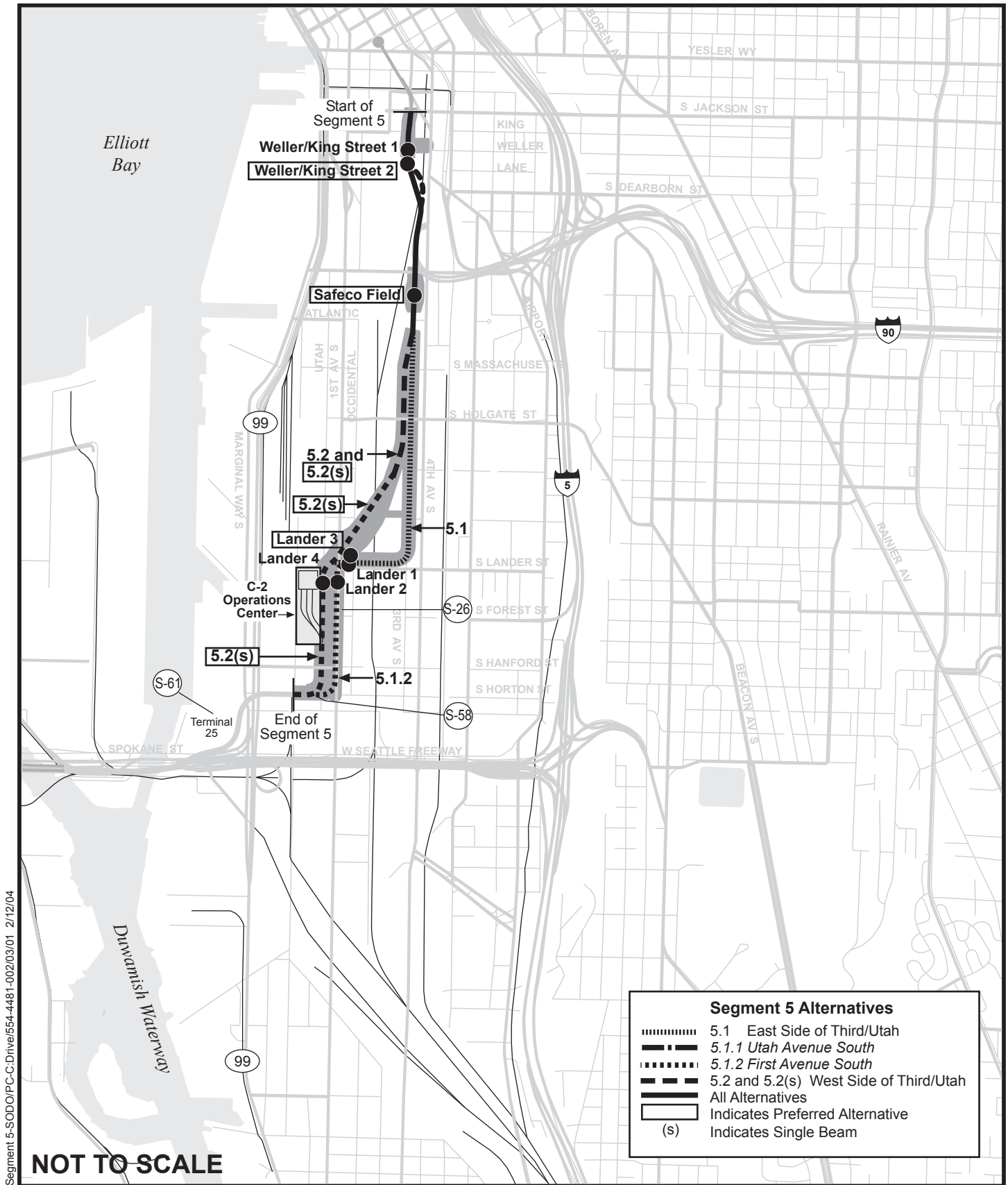


Figure 4.11-3
Segment 3 and 4: Queen Anne/
Seattle Center/Belltown,
Downtown/Pioneer Square
Historic Resources Listed in or
Eligible for Historic Registers

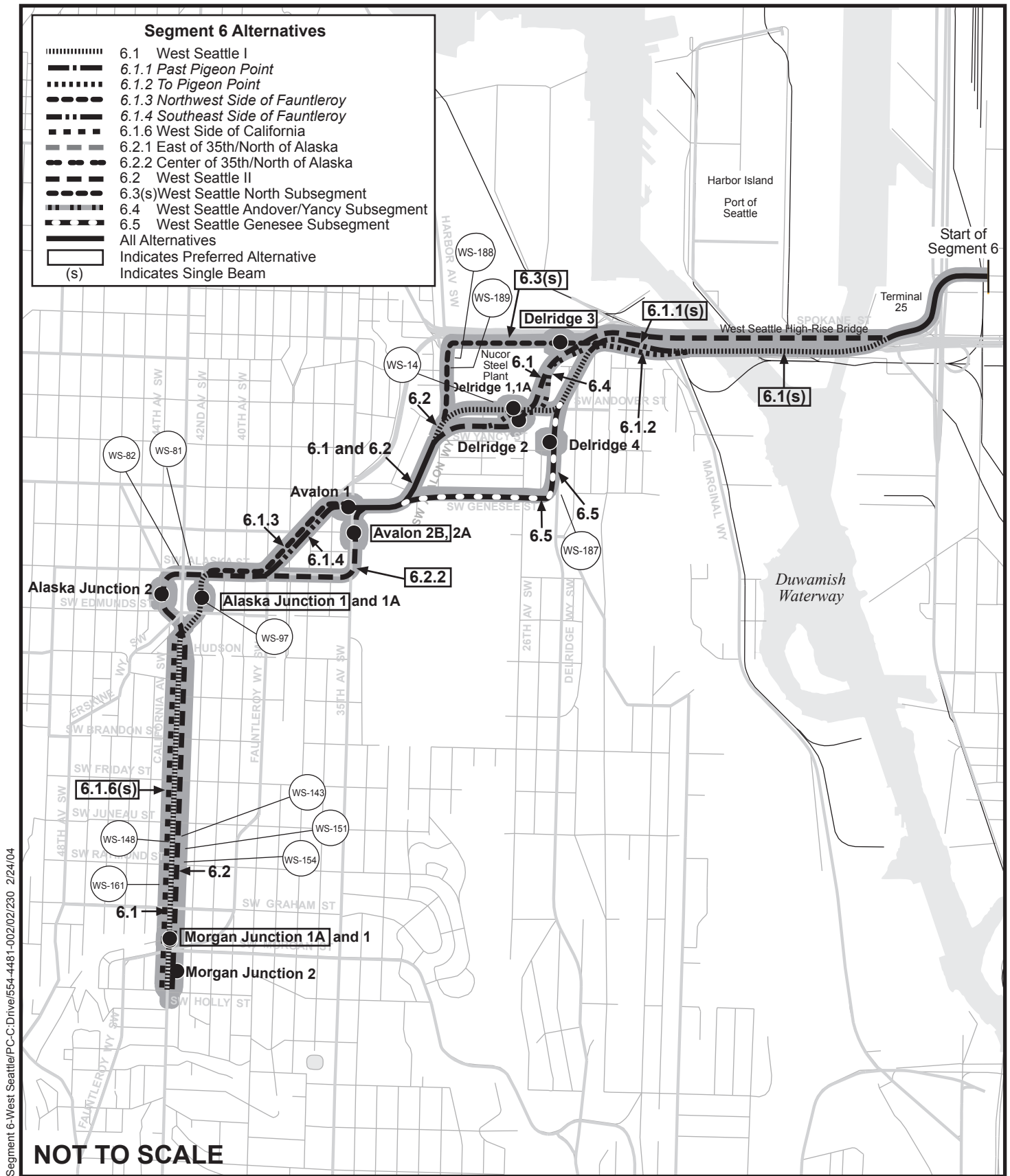


Segment 5-SODO/PC-C:Drive/554-4481-002/03/01 2/12/04



Area of Potential Effect (APE)
for Buildings and Structures

Figure 4.11-4
Segment 5: SODO/Chinatown
International District/Pioneer Square
Historic Resources Listed in or
Eligible for Historic Registers



Segment 6-West Seattle/PC-C:Drive/554-4481-002/02/230 2/24/04



Area of Potential Effect (APE)
for Buildings and Structures

Figure 4.11-5
Segment 6: West Seattle
Historic Resources Listed in or
Eligible for Historic Registers

Table 4.11-1. Historic Resources in the Area of Potential Effect Listed in the NRHP, Washington Heritage Register, as National Historic Landmark, Designated a Seattle City Landmark, or Determined Eligible for the NRHP

Inventory No.	Resource/Address	Historic Register
Ballard Segment		
B-60	Residence, 7353 15 th Avenue NW	NRHP Eligible
B-114	Apartments, 1505 NW 60 th Street	NRHP Eligible
B-131	Mike's Chili Parlor, 1447 NW Ballard Way	NRHP Eligible
B-132	Brekke Co. Steel Fabricators, 1526 NW 46 th Street	NRHP Eligible
B-140	Ballard Bridge	NRHP Listed
Interbay/Magnolia Segment		
I-1C	Residence and Storage, Fishermen's Terminal	NRHP Eligible
I-19	Residence, 1414 Dravus Street W	NRHP Eligible
I-25	Residence, 3036 16 th Avenue W	NRHP Eligible
I-26	Residence, 3032 16 th Avenue W	<i>Seattle Landmark Eligible</i>
I-52	Tsubota Steel and Pipe, 1641a 15 th Avenue W	NRHP Eligible
I-66	Leibold Communications Inc., 1450 15 th Avenue W	NRHP Eligible
I-72	Ace Tank, 1123a Elliott Avenue W	NRHP Eligible
I-73	Ace Tank, 1123b Elliott Avenue W	NRHP Eligible
I-74	Ace Tank, 1123c Elliott Avenue W	NRHP Eligible
I-80	Wilson Machine Works, 1038 Elliott Avenue W	NRHP Eligible
I-86	Phillips Scale Co., 934b Elliott Avenue W	NRHP Eligible
Queen Anne/Seattle Center/Belltown Segment		
SC-7	7 Queen Anne Avenue N	NRHP Eligible
SC-8	Dalmasso Apartments, 26 W Harrison Street	NRHP Eligible ¹
SC-13	Queen Anne Apartments, 505 First Avenue N)	NRHP Eligible
SC-15	Center House (Seattle Center), 305 Harrison Street	NRHP Eligible
SC-16	Monorail Terminal, Office, and Track, Seattle Center	NRHP Eligible
SC-20	Auditorium Apartments, 605 Fifth Avenue N	NRHP Eligible
SC-22	Memorial Stadium, Seattle Center	NRHP Eligible
SC-31	Space Needle, 305 Harrison Street	NRHP Eligible, Seattle Landmark
SC-32	Seattle Center Fountain, 305 Harrison Street	NRHP Eligible
Downtown/Pioneer Square Segment		
D-2	Seattle, Chief of the Suquamish Statue, Fifth Avenue, Denny Way, and Cedar Street	Listed NRHP, Seattle Landmark
D-5	2619 Fifth Avenue	NRHP Eligible
D-7	420 Vine Street	NRHP Eligible
D-10	Fire Station No. 2, 2318 Fourth Avenue	NRHP Eligible, Seattle Landmark
D-17	420 Blanchard Street	NRHP Eligible
D-18	Fifth Avenue Court Apartments, 2132 Fifth Avenue	NRHP Eligible
D-26	Sheridan Apartments, 2011 Fifth Avenue	NRHP Eligible
D-27	Griffin Building, 2005 Fifth Avenue	Potentially Seattle Landmark Eligible
D-33	Centennial Building, 1900-1910 Fourth Avenue	NRHP Eligible
D-34	Times Square Building, 414 Olive Way	NRHP Listed, Seattle Landmark
D-35	McGraw Square, Fifth Avenue/Westlake Avenue/Olive Way/Stewart Street	Seattle Landmark
D-36	Mayflower Park Hotel, 1630 Fourth Avenue	NRHP Eligible
D-37	Securities Building, 1904 Third Avenue	NRHP Eligible

Table 4.11-1. Historic Resources in the Area of Potential Effect Listed in the NRHP or Washington Heritage Register, Designated a Seattle City Landmark, or Determined Eligible for the NRHP (continued)

Inventory No.	Resource/Address	Historic Register
Downtown/Pioneer Square Segment (continued)		
D-38	Bon Macy's, 300 Stewart Street	NRHP Eligible, Seattle Landmark
D-40	Josephinum Hotel, 1900 Second Avenue	Listed NRHP, Seattle Landmark
D-42	Caffe D'Arte, 125 Stewart Street	NRHP Eligible
D-43	Inn at the Market, 1601 First Avenue (modern)	NRHP Listed (intrusion PPHD) ²
D-46	Triangle Market, 1532 Pike Place	NRHP Listed (PPHD)
D-47	First and Pine Building, 1535 First Avenue	NRHP Listed (PPHD)
D-49	Doyle Building, 1527 Second Avenue	NRHP Listed
D-50	Haight Building (Second Ave and Pike Building), 211 Pine Street	NRHP Eligible
D-51	United Shopping Tower/Olympic Tower, 217 Pine Street	NRHP Listed, Seattle Landmark
D-54	Corner Market, NW corner of First Avenue and Pike Street	NRHP Listed (PPHD)
D-57	Eitel Building, 1511 Second Avenue	NRHP Eligible
D-59	Economy Market, SW corner of First Avenue and Pike Street	NRHP Listed (PPHD)
D-64	Hadfield Building, 1201 Second Avenue	NRHP Eligible, Seattle Landmark
D-66	Baillargeon Building, 1100 Second Avenue	NRHP Eligible
D-67	Federal Reserve Bank Building, 1015 Second Avenue	NRHP Eligible
D-68	Exchange Building, 821 First Avenue	NRHP Eligible, Seattle Landmark
D-69	Puget Sound Bank (Bank of California), 815 Second Avenue	NRHP Eligible, Seattle Landmark
D-72	Seattle Trust and Savings Bank, 804 Second Avenue	NRHP Eligible
D-73	Hong Kong and Shanghai Banking Corporation Clock, 720 Second Avenue	NRHP Eligible, Seattle Landmark
D-74	Foster and Marshall Building, 720 Second Avenue	NRHP Eligible
D-75	Chamber of Commerce Building, 215 Columbia Street	NRHP Eligible
D-76	Metsker Maps, 700 First Avenue	NRHP Listed (PSHD)
D-77	Hoge Building (Carson Boren Home Site), 705 Second Avenue	NRHP Listed, Seattle Landmark
D-78	Dexter Horton Building, 710 Second Avenue	NRHP Eligible, Seattle Landmark
D-79	Mutual Life Building, 605 First Avenue	NRHP Listed (PSHD)
D-80	Lowman Building, 107 Cherry Street	NRHP Listed (PSHD)
D-81	Broderick Building (Seattle's Best Coffee), 619 Second Avenue	NRHP Listed (PSHD)
D-82	Alaska Building, 618 Second Avenue	NRHP Listed (PSHD)
D-85	Pioneer Building , Pergola and Totem Pole 606 First Avenue	NRHP Listed (PSHD), NHL
D-86	Butler Garage, 601 Second Avenue	NRHP Listed (PSHD)
D-87	610 Second Avenue	NRHP Listed (PSHD)
D-88	Hartford Building, 600 Second Avenue	NRHP Listed (PSHD)
D-89	Lyon Building, 601 Third Avenue	NRHP Eligible
D-90	Café Paloma, 93 Yesler Way	NRHP Listed (PSHD)
D-91	Tully's Coffee, 99 Yesler Way	NRHP Listed (PSHD)
D-92	Collins Building, 520 Second Avenue	NRHP Listed (PSHD)
D-93	519 Third Avenue	NRHP Listed (PSHD)
D-94	512 Second Avenue	NRHP Listed (PSHD)
D-95	Smith Tower, 502 Second Avenue	NRHP Listed (PSHD), Seattle Landmark
D-96	Merchant's Café, 109 Yesler Way	NRHP Listed (PSHD)
D-97	Bohemian Nightclub, 115 Yesler Way	NRHP Listed (PSHD)
D-98	Flanagan and Lane , 102 Yesler Way	NRHP Listed (PSHD)
D-99	Metropole Market, 423 Second Avenue Extension S	NRHP Listed (PSHD)
D-100	201 Yesler Way	NRHP Listed (PSHD)
D-101	Frye Apartments, 223 Yesler Way	NRHP Listed (PSHD)

Table 4.11-1. Historic Resources in the Area of Potential Effect Listed in the NRHP or Washington Heritage Register, Designated a Seattle City Landmark, or Determined Eligible for the NRHP (continued)

Inventory No.	Resource/Address	Historic Register
Downtown/Pioneer Square Segment (continued)		
D-102	408 Second Avenue Extension S	NRHP Listed (intrusion PSHD) ²
D-103	411 Second Avenue Extension S	NRHP Listed (intrusion PSHD) ²
D-104	410 Second Avenue Extension S	NRHP Listed (intrusion PSHD) ²
D-105	The Last Supper Club, 124 S Washington Street	NRHP Listed (PSHD)
D-106	401 Second Avenue Extension S	NRHP Listed (intrusion PSHD) ²
D-107	406 Second Avenue Extension S	NRHP Listed (PSHD)
D-108	400 Second Avenue Extension S	NRHP Listed (PSHD)
D-109	165 S Washington Street	NRHP Listed (PSHD)
D-110	McCoys Firehouse, 173 S Washington Street	NRHP Listed (intrusion PSHD) ²
D-111	201 S Washington Street	NRHP Listed (PSHD)
D-112	Union Gospel Mission, 211 S Washington Street	NRHP Listed (intrusion PSHD) ²
D-113	Mathews and Chesnin Attorneys, 219 S Washington Street	NRHP Listed (PSHD)
D-114	Union Gospel Mission, 221 S Washington Street	NRHP Listed (PSHD)
D-115	313 Second Avenue Extension S	NRHP Listed (PSHD)
D-116	208 Second Avenue Extension S	NRHP Listed (PSHD)
D-117	Masins Fine Furniture, 220 S Main Street	NRHP Listed (PSHD)
D-118	Comedy Underground, 222 S Main Street	NRHP Listed (PSHD)
D-119	Seattle Fire Department Fire Prevention, 220 Third Avenue	NRHP Listed (PSHD)
D-120	213 S Main Street	NRHP Listed (PSHD)
D-121	222 S Main Street	NRHP Listed (PSHD)
D-122	James Harris Gallery, 307 Second Avenue Extension S	NRHP Listed (PSHD)
D-123	Seattle Lighting Fixture Co., 210 Second Avenue Extension S	NRHP Listed (intrusion PSHD) ²
D-124	Vacant, 208 S Jackson Street	NRHP Listed (PSHD)
D-125	Leathers/Gourmet Sausage Co., 315 S Jackson Street	NRHP Listed (PSHD)
D-126	King Street Station, 301 S Jackson Street	NRHP Listed (PSHD)
D-127	Pioneer Square Historic District Areaways	NRHP Eligible
D-127a	Sinking Ship Garage Areaway	NRHP Eligible
D-127b	Butler Garage Areaway, 601 Second Ave.	NRHP Eligible
D-127c	Broderick Building Areaway, 619 Second Ave.	NRHP Eligible
D-128	Times Square Building Areaway	NRHP Eligible (Pending SHPO)
D-129	Columbia Building Areaway	NRHP Eligible (Pending SHPO)
D-131	Pike Place Public Market Historic District	NRHP Listed, Seattle Landmark
D-132	Pioneer Square Historic District	NRHP Listed, Seattle Landmark
SODO/Chinatown International District/Pioneer Square Segment		
S-26	Bank of America, 2764 First Avenue S	NRHP Eligible
S-58	Markey Machinery Co., 79 S Horton Street	NRHP Eligible
S-61	Rainier Cold Storage Building A, southeast corner of S Horton Street and Colorado Avenue S	NRHP Eligible
West Seattle Segment		
WS-14	Nucor Steel Mill, 2424 SW Andover Street	NRHP Eligible
WS-81	Cherry Creek Furniture, 4554 California Avenue SW	Seattle Landmark Eligible
WS-82	Easy Street Records, 4302 SW Alaska Street	Seattle Landmark Eligible
WS-97	Curious Kidstuff, 4740 California Avenue SW	Seattle Landmark Eligible
WS-116	Apartment Building, 5202 California Ave. SW	NRHP Eligible
WS-117	Apartment Building, 5206 California Ave. SW	NRHP Eligible
WS-129	Residence, 5440 California Ave. SW	NRHP Eligible

Table 4.11-1. Historic Resources in the Area of Potential Effect Listed in the NRHP or Washington Heritage Register, Designated a Seattle City Landmark, or Determined Eligible for the NRHP (continued)

Inventory No.	Resource/Address	Historic Register
WS-143	Farmers Insurance Group, 5922 California Avenue SW	NRHP Eligible
WS-148	Residence, 5933 California Avenue SW	NRHP Eligible
WS-151	Residence, 5948 California Avenue SW	NRHP Eligible
WS-154	Residence, 5956-5958 California Avenue SW	NRHP Eligible
WS-187	Cooper Elementary School, 4408 Delridge Way	Seattle Landmark, NRHP Eligible (Pending SHPO)
WS-188	Boysen Apartments, 2906 SW Avalon Way	NRHP Eligible (Pending SHPO)
WS-189	Shack Coffee Shop, 2920 SW Avalon Way	NRHP Eligible (Pending SHPO)

¹ This building is not eligible by itself, but it is eligible as part of a group of similar properties.

² Intrusion Pike Place Public Market Historic District/Pioneer Square Historic District (PPHD/PSHD)¹ = an intrusion is a building that falls within the boundaries of the historic district but is not a contributing structure to that district.

³ All buildings within Pioneer Square Historic District (PSHD) are included within the Pioneer Square Preservation District (PSPD).

Segment 2: Interbay/Magnolia Segment

Eleven resources in the Interbay/Magnolia Segment have been determined eligible for historic registers, including three residences (I-19, I-25, and I-26), Tsubota Steel and Pipe (I-52), Leibold Communications, Inc. (I-66), the Ace Tank complex (I-72, I-73, I-74), Wilson Machine Works (I-80), Phillips Scale Co. (I-86), and a Fishermen's Terminal building (I-1C). The background field inventory in the Interbay Segment reviewed 100 resources within the APE, including 39 resources that were Category A or B properties, which were researched and further evaluated for listing in historic registers. The north end of this segment is characterized by commercial and industrial structures, with multifamily residences to the east. The southern portion of the Interbay Segment includes an increased number of multifamily residential buildings along Elliott Avenue W.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Nine historically significant resources listed in or eligible for historic registers are within the Queen Anne/Seattle Center/Belltown Segment APE. The historically significant resources within this segment include four apartment buildings (SC-7, SC-8, SC-13, and SC-20), Center House (SC-15); Monorail Terminal, Office, and Track (SC-16); Memorial Stadium (SC-22); Space Needle (SC-31); and the Seattle Center Fountain (SC-32). In the background field investigation, 32 resources were reviewed, including 14 resources that were Category A or B properties, which were researched further and evaluated for listing in historic registers. Apart from the Seattle Center itself, this segment consists of a mix of high-density residential (apartments) and small- to medium-sized commercial buildings. A significant amount of land in this segment is occupied by parking facilities, especially adjacent to the Seattle Center campus.

Segment 4: Downtown/Pioneer Square Segment

The Downtown/Pioneer Square Segment includes the original center of development of the City of Seattle (Pioneer Square) and one of the first areas to be expanded as the city grew into the region's dominant commercial center. It includes both the Pioneer Square and Pike Place historic districts. Ninety resources within this segment are listed in or eligible for historic registers. A large number of resources that were identified in the APE have been previously listed in the NRHP and as Seattle Landmarks as part of the Pioneer Square Historic District and Pioneer Square Preservation District.

The NRHP Pike Place Public Market Historic District boundaries extend roughly from Western Avenue on the west, Pike Street on the south, First Avenue on the east, and Virginia Street on the north. The local Pike Place Market Historical District shares similar boundaries but extends further south to Union Street. The NRHP Pioneer Square Historic District extends roughly from Alaskan Way to the west, S King Street to the south, Fourth and Fifth Avenues S to the east, and Columbia, Cherry, James, and Jefferson Streets

to the north. However, the NRHP district boundaries extend further in several areas, including the area bordered by First and Occidental Avenues S south of S King Street. The local Pioneer Square Preservation District boundaries encompass most of this same area, but include more territory, including additional area bordered by First and Occidental Avenues S south of S King Street, and a dock at the foot of S. Washington Street. The historic properties within these districts are located in both the Green Line's SODO/Chinatown International District/Pioneer Square and Downtown/Pioneer Square Segments. To evaluate affected resources and effects to these resources as part of a single historic district, all historical resources within the Pioneer Square Historic District and Pioneer Square Preservation District have been assessed as part of the Downtown/Pioneer Square Segment.

Properties along the southern part of Second Avenue in this segment include the 42-story Smith Tower (1914), the Dexter Horton Building (1924), the Hartford Building (1929), and the Exchange Building (1930), which also was one of Seattle's last and most stylish Art Deco skyscrapers. After this time, most new business construction was happening uptown near the Metropolitan Tract. As the new business district developed and thrived, Pioneer Square slid into decline; a "Hooverville" (community of homeless people) developed along the waterfront south of the Square during the Depression (Crowley 1998; Woodbridge and Montgomery 1980). Despite the replacement of many of the original commercial buildings over the years, numerous historical buildings remain. A significant ensemble of resources within the Pioneer Square Historic District include the Pioneer Building, Pergola, and Totem Pole (D-85), listed in the National Register Historic District and as a National Historic Landmark (NHL).

Pike Place Market, a block west of the proposed Green Line alternative alignments, is a Seattle icon made up of a "maze of structures that have housed a continuously operating public farmers' market and miscellaneous other merchants since 1907" (Crowley 1998:77). Developers built a permanent arcade to house the farmers and vendors and also constructed the Outlook Hotel and the Triangle Market. The market area was expanded in 1910 and again in 1911; a few years later, the Fairley (Main Market) Building was erected. By 1917, all the main buildings of the current market were in place. The neon sign and giant clock were added around 1930.

A total of 116 Category A and B resources were evaluated for listing in historic registers. Among these resources the areaways, located underground within the Pioneer Square Historic District, have been identified as one resource (D-127). The following three Pioneer Square Historic District areaways would have the potential of being affected by the Green Line and have been assigned specific resource numbers: Sinking Ship Garage Areaway (D-127a), Butler Garage Areaway (D-127b) and Broderick Building Areaway (D-127c). Outside the Pioneer Square Historic District, the areaways along Second and Fifth Avenues were evaluated for NRHP eligibility after the completion of the Draft EIS and are included in Tables 4.11.2 and 4.11.3. (an areaways report is included in the Section 106 Cultural Resources Report, Appendix NN). Two of these areaways (D-128 and D-129), were found eligible for the NRHP. Details on the individual resources are provided within the Section 106 Cultural Resources Report (Appendix NN) and also were included in the documentation provided to the SHPO and the City of Seattle.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

As noted above, historical resources in the Pioneer Square Historic District and Pioneer Square Preservation District were evaluated as part of the Downtown/Pioneer Square Segment.

The SODO/Chinatown International District/Pioneer Square Segment historical resources inventory considers the area south of S King Street. The background field inventory for the SODO Segment reviewed 61 buildings or structures in the APE, and seven were researched further and evaluated for listing in historic registers. The following three resources were determined eligible for the NRHP: the Markey Machinery Building (S-58), Rainier Cold Storage Building A (S-61), and the Bank of America branch (S-26).

The SODO area is a commercial and industrial part of the city that exhibits a land use trend initiated by the railroads that built trestles over the Elliott Bay tidelands before they were filled. Railroad companies moved quickly to occupy the reclaimed lands as filling progressed. A series of public stadium projects has altered the northernmost portion of the SODO/Chinatown International District/Pioneer Square Segment, but many older commercial buildings remain south of Safeco Field.

Segment 6: West Seattle Segment

The background field inventory of the West Seattle Segment considered 227 resources within the APE, including 34 that were evaluated for eligibility for historic registers. The West Seattle project area is largely residential, with small to medium sized businesses clustered around major street intersections.

Fourteen resources within the West Seattle Segment have historical significance. The historic resources within the segment include the Nucor Steel Mill (WS-14), Curious Kidstuff (WS-97), Farmers Insurance Group Building (WS-143), Cherry Creek Furniture (WS-81), Easy Street Records (WS-82), two apartment buildings (WS-116 and WS-117) and four residential buildings (WS-129, WS-148, WS-151, and WS-154). The four residential buildings were eligible for inclusion in the NRHP, and three commercial buildings (WS-81, WS-82, and WS-97) were previously determined eligible as Seattle Landmarks. In order to address comments received on the Draft EIS, research was conducted between the publishing of the Draft EIS and Final EIS that identified three buildings that appear eligible for the NRHP. These buildings are the Cooper Elementary School (WS-187), Boysen Apartments (WS-188), and The Shack Coffee Shop (WS-189).

4.11.3 Impacts

Impacts to archaeological resources in the project alternatives and Preferred Alternative would be limited to Green Line construction, including locations of guideway columns, bridge piers, Operations Center alternatives, several stations where buildings could be removed, and/or stations where grading could penetrate fill into native soils. Construction impacts are expected to be localized at a few of the many guideway columns or stations. Most unknown significant archaeological resources that may occur in the APE would not be affected because of the small construction footprints of guideway columns, although underground utility relocation activities would also encounter archeological resources.

Historic resources listed in or eligible for historic registers were evaluated to determine potential effects of station and alignment alternatives on those resources. Analysis of potential effects to historic resources assessed the different actions that could occur during Green Line construction and operation. When interpreting short- and long-term impacts under SEPA and NEPA that may cause adverse effects, the following criteria are evaluated:

- **Demolition or Alteration of Property:** The demolition or extensive alteration of all or part of the resource.
- **Isolation/Alteration of Surrounding Environment:** Temporary or permanent restrictions of access to a historic resource or a change in the character of the property's setting.
- **Traffic Congestion/Parking/Access:** Congestion arising from changes in traffic patterns, parking, and access to historic resources.
- **Visual:** The introduction of modern construction or the removal of historic resources adjacent to a historic property that are out of character with or alter the resource's historical setting.
- **Introduction of New Construction:** The addition of new construction that is not compatible with the existing architecture of historic resources.
- **Structural Instability:** Introduction of vibration during construction or operation that would cause damage to historic resources.

- **Noise:** The introduction of audible elements that are out of character with the historic resource and its established use such that its use may be altered or abandoned.
- **Change of Use:** The change in use of a historic resource brought about by construction or operation-related activities that make it no longer physically or financially feasible or desirable to maintain the current use.
- **Vibration:** Construction or operation techniques that would create vibrations such that a resource may experience damages such as the loosening of paint or mortar, cracking of mortar or plaster, weakening of structural elements, or crumbling masonry.
- **Temporary Dirt/Unintended Damage:** The introduction of atmospheric elements that may alter or damage a historic resource.
- **Neglect:** neglect of a resource resulting in its deterioration or demolition. This is a potential effect assessed under no-build alternatives (e.g., the No Action Alternative).

The following discussion provides a summary of potential effects to historic resources for each Green Line alignment and station alternative. Table 4.11-2 summarizes the numbers of historic resources that could experience adverse effects. Table 4.11-3 provides information on the level of effects to historic resources under each alternative. The adverse effect discussion for each segment also provides a description of historic resources within the alignment and station alternatives and the level of effects associated with each resource.

Other sections of this Final EIS, including Transportation (4.1), Displacements and Relocation (4.2), Land Use and Neighborhoods (4.3), Visual Quality and Aesthetic Resources (4.5), Noise and Vibration (4.7), and Construction (4.17), provide additional discussion on potential impacts that could affect historic properties, and these effects were also considered in the determination of effects to historic properties. However, the secondary impacts from these other environmental areas, except visual quality, were not found to adversely affect historic properties. There are no long-term operational vibration impacts that would create adverse effects to historic resources. Some historic resources within the APE would have adverse visual effects due to the construction of the Green Line. The Section 106 Cultural Resource Report (Appendix NN) includes visual simulations that illustrate adverse effects to specific historic resources.

Table 4.11-2. Summary of Adverse Effects to Historic Resources

Alignment Alternative	Historic
1. Ballard	
1.1 West Side of 15 th or 1.1(s) West Side of 15 th single beam	5
1.2 Center of 15 th	4
Preferred Alternative	5
2. Interbay/Magnolia	
2.1 West Side of 15 th /Center of Elliott or 2.1(s) (single beam)	8 to 9
2.2 Center of 15 th /West Side of Elliott	6
Preferred Alternative	10
3. Queen Anne/Seattle Center/Belltown	
3.1 Seattle Center/Republican	5
3.2 Mercer	4

Table 4.11-2. Summary of Adverse Effects to Historic Resources (continued)

Alignment Alternative	Historic
3.3 Thomas	4
3.5 Second/Denny	3
Preferred Alternative	5
4. Downtown/Pioneer Square	
4.1 West Side of Second	80 to 84
4.2 East Side of Second with Crossover	81
4.3 Center of Second	79
4.4 East Center of Second	81
Preferred Alternative	84
5. SODO/Chinatown International District/Pioneer Square	
5.1 East Side of Third/Utah	2
5.2 West Side of Third/Utah or 5.2(s) (single beam)	3
Preferred Alternative	2
6. West Seattle	
6.1 West Seattle I or 6.1(s) (single beam)	9
6.2 West Seattle II	10
6.3(s) Delridge North Subsegment	3
6.4 Andover/Yancy Subsegment	1
6.5 Genesee Subsegment	1
Preferred Alternative	11
Operations Center	
C-1 Interbay	0
C-2 SODO	0

Table 4.11-3. Evaluation of Effects and Adverse Effects by Alternative

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
Ballard Segment, Alternative 1.1 or 1.1(s)- West Side of 15 th					
B-60 Residence 7353 15 th Avenue NW	Eligible				X
B-114 Apartments 1505 NW 60 th Street	Eligible				X
B-131 Mike's Chili Parlor 1447 NW Ballard Way	Eligible				X
B-132 Brekke Co. Steel Fabricators 1526 NW 46 th Street	Eligible				X
B-140 Ballard Bridge	NRHP			X	X
Ballard Segment, Alternative 1.2 – Center of 15 th					
B-60 Residence 7353 15 th Avenue NW	Eligible				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
B-114 Apartments 1505 NW 60 th Street	Eligible				X
B-131 Mike's Chili Parlor 1447 NW Ballard Way	Eligible			X	X
B-140 Ballard Bridge	NRHP			X	X
Ballard Segment, Preferred Alternative					
B-60 Residence 7353 15 th Avenue NW	Eligible				X
B-114 Apartments 1505 NW 60 th Street	Eligible				X
B-131 Mike's Chili Parlor 1447 NW Ballard Way	Eligible				X
B-132 Brekke Co. Steel Fabricators 1526 NW 46 th Street	Eligible				X
B-140 Ballard Bridge	NRHP			X	X
Interbay/Magnolia Segment, Alternative 2.1 or 2.1(s) - West Side of 15th/Center of Elliott					
I-25 Residence 3036 16 th Avenue W	Eligible		X		
I-26 Residence 3032 16 th Avenue W	Potential SLE		X		
I-52 Tsubota Steel and Pipe 1641a 15 th Avenue W	Eligible		X ^a		X
I-66 Leibold Communications Inc. 1450 15 th Avenue W	Eligible	X			
I-72 Ace Tank 1123a Elliott Avenue W	Eligible				X
I-73 Ace Tank 1123b Elliott Avenue W	Eligible				X
I-74 Ace Tank 1123c Elliott Avenue W	Eligible				X
I-80 Wilson Machine Works 1038 Elliott Avenue W	Eligible				X
I-86 Phillips Scale Co. 934b Elliott Avenue W	Eligible				X
Interbay/Magnolia Segment, Alternative 2.1.1 - West Bridge Connection					
I-1C Storage Building Fishermen's Terminal	Eligible			X	X
Interbay/Magnolia Segment, Alternative 2.1.2 - Far West Bridge Connection					
No eligible historic resources					
Interbay/Magnolia Segment, Alternative 2.2 - Center of 15th/West Side of Elliott					
I-19 Residence 1414 Dravus Street W	Eligible	X			
I-52 Tsubota Steel and Pipe 1641a 15 th Avenue W	Eligible				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
I-66 Leibold Communications Inc. 1450 15 th Avenue W	Eligible	X			
I-72 Ace Tank 1123a Elliott Avenue W	Eligible				X
I-73 Ace Tank 1123b Elliott Avenue W	Eligible				X
I-74 Ace Tank 1123c Elliott Avenue W	Eligible				X
I-80 Wilson Machine Works 1038 Elliott Avenue W	Eligible				X
I-86 Phillips Scale Co. 934b Elliott Avenue W	Eligible				X
Interbay/Magnolia Segment, Preferred Alternative					
I-25 Residence 3036 16 th Avenue W	Eligible		X		
I-26 Residence 3032 16 th Avenue W.	Eligible		X		
I-52 Tsubota Steel and Pipe 1641a 15 th Avenue W	Eligible		X ^a		X
I-66 Leibold Communications Inc. 1450 15 th Avenue W	Eligible	X			
I-72 Ace Tank 1123a Elliott Avenue W	Eligible				X
I-73 Ace Tank 1123b Elliott Avenue W	Eligible				X
I-74 Ace Tank 1123c Elliott Avenue W	Eligible				X
I-80 Wilson Machine Works 1038 Elliott Avenue W	Eligible				X
I-86 Phillips Scale Co. 934b Elliott Avenue W	Eligible				X
I-1C Storage Building Fishermen's Terminal	Eligible			X	X
Queen Anne/Seattle Center/Belltown Segment, Alternative 3.1 - Seattle Center/Republican					
SC-7 7 Queen Anne Avenue N					X
SC-8 Dalmasso Apartments* 26 W Harrison Street	Eligible		X		
SC-13 Queen Anne Apartments 505 First Avenue N	Eligible	X			
SC-15 Center House (Seattle Center) 305 Harrison Street	Eligible				X
SC-16 Monorail Terminal, Office, and Track - Seattle Center	Eligible		X		
SC-22 Memorial Stadium	Eligible				X
SC-31 Space Needle	Eligible	X			

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
SC-32 Seattle Center Fountain	Eligible	X			
* The Dalmasso Apartments is not eligible by itself, but is eligible as part of a group of similar properties.					
Queen Anne/Seattle Center/Belltown Segment, Alternative 3.2 – Mercer**					
SC-7 7 Queen Anne Avenue N	Eligible				X
SC-8 Dalmasso Apartments** 26 W Harrison Street	Eligible		X		
SC-13 Queen Anne Apartments 505 First Avenue N	Eligible	X			
SC-16 Monorail Terminal, Office, and Track - Seattle Center	Eligible		X		
SC-20 Auditorium Apartments 605 Fifth Avenue N	Eligible				X
SC-31 Space Needle	Eligible	X			
SC-32 Seattle Center Fountain	Eligible	X			
** The Dalmasso Apartments is not eligible by itself, but is eligible as part of a group of similar properties. The Dalmasso Apartments would not be demolished, however, the property would be altered by the Green Line over the property.					
Queen Anne/Seattle Center/Belltown Segment, Alternative 3.3 - Thomas					
SC-7 7 Queen Anne Avenue N	Eligible				X
SC-8 Dalmasso Apartments* 26 W Harrison Street	Eligible				X
SC-13 Queen Anne Apartments 505 First Avenue N	Eligible	X			
SC-15 Center House (Seattle Center) 305 Harrison Street	Eligible				X
SC-16 Monorail Terminal, Office, and Track - Seattle Center	Eligible		X		
SC-31 Space Needle	Eligible				X
SC-32 Seattle Center Fountain	Eligible	X			
* The Dalmasso Apartments is not eligible by itself, but is eligible as part of a group of similar properties.					
Queen Anne/Seattle Center/Belltown Segment, Alternative 3.5 - Second/Denny					
SC-7 7 Queen Anne Avenue N	Eligible				X
SC-8 Dalmasso Apartments** 26 West Harrison Street	Eligible				X
SC-16 Monorail Terminal, Office, and Track - Seattle Center	Eligible		X		
** The Dalmasso Apartments is not eligible by itself, but is eligible as part of a group of similar properties. The Dalmasso Apartments would not be demolished, however, the property would be altered by the Green Line over the property.					
Queen Anne/Seattle Center/Belltown Segment, Preferred Alternative					
SC-7 7 Queen Anne Avenue N	Eligible				X
SC-8 Dalmasso Apartments** 26 W Harrison Street	Eligible		X		
SC-13 Queen Anne Apartments 505 First Avenue N	Eligible	X			

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
SC-15 Center House (Seattle Center) 305 Harrison Street	Eligible				X
SC-16 Monorail Terminal, Office, and Track - Seattle Center	Eligible		X		
SC-22 Memorial Stadium	Eligible				X
SC-31 Space Needle	Eligible	X			
SC-32 Seattle Center Fountain	Eligible	X			
** The Dalmasso Apartments is not eligible by itself, but is eligible as part of a group of similar properties. The Dalmasso Apartments would not be demolished, however, the property would be altered by the Green Line over the property.					
Downtown/Pioneer Square Segment, Alternative 4.1 - West Side of Second					
D-2 Seattle, Chief of the Suquamish Statue/Fifth Avenue, Denny Way, and Cedar Street	Listed NR				X
D-5 2619 Fifth Avenue	Eligible				X
D-7 420 Vine Street	Eligible				X
D-10 Fire Station No. 2 2318 Fourth Avenue	Eligible	X			
D-17 420 Blanchard Street	Eligible				X
D-18 Fifth Avenue Court Apartments 2132 Fifth Avenue	Eligible				X
D-26 Sheridan Apartments 2011 Fifth Avenue	Eligible				X
D-27 Griffin Building 2005 Fifth Avenue	Potential SLE*				X
D-33 Centennial Building 1900-1910 Fourth Avenue	Eligible		X ^b		X ^c
D-34 Times Square Building 414 Olive Way	Listed NR				X
D-36 Mayflower Park Hotel 1630 Fourth Avenue	Eligible				X
D-35 McGraw Square Fifth Avenue/Westlake Avenue/Olive Way/Stewart Street	Seattle Landmark				X
D-37 Securities Building 1904 Third Avenue	Eligible				X
D-38 Bon Marche 300 Stewart Street	Eligible				X
D-40 Josephinum Hotel 1900 Second Avenue	Listed NR				X
D-42 Caffè D'Arte 125 Stewart Street	Eligible				X
D-43 Inn at the Market (modern) 1601 First Avenue	Listed NR PPHD	X			
D-46 Triangle Market 1532 Pike Place	Listed NR PPHD				X ^d

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-47 First and Pine Building 1535 First Avenue	Listed NR PPHD				X ^d
D-49 Doyle Building 1527 Second Avenue	Listed NR			X	X
D-50 Haight Building 211 Pine Street	Eligible				X
D-51 United Shopping Tower/Olympic Tower 217 Pine Street	Listed NR				X
D-54 Corner Market NW corner of First Avenue and Pike Street	Listed NR PPHD				X ^d
D-57 Eitel Building 1511 Second Avenue	Eligible		X ^e		X ^d
D-59 Economy Market SW corner of First Avenue and Pike Street	Listed NR PPHD				X ^d
D-64 Hadfield Building 1201 Second Avenue	Eligible				X
D-66 Baillargeon Building 1100 Second Avenue	Eligible				X
D-67 Federal Reserve Bank Building 1015 Second Avenue	Eligible		X		
D-68 Exchange Building 821 First Avenue	Eligible				X
D-69 Puget Sound Bank (Bank of California) 815 Second Avenue	Eligible				X
D-72 Seattle Trust and Savings Bank / 804 Second Avenue	Eligible				X
D-73 Hong Kong and Shanghai Banking Corporation Clock 720 Second Avenue	Eligible				X
D-74 Foster and Marshall Building 720 Second Avenue	Eligible				X
D-75 Chamber of Commerce Building/215 Columbia Street	Eligible				X
D-76 Metsker Maps 700 First Avenue	Listed NR PSHD				X
D-77 Hoge Building (Carson Boren Home Site) 705 Second Avenue	Listed NR				X
D-78 Dexter Horton Building 710 Second Avenue	Eligible				X
D-79 Mutual Life Building 605 First Avenue	Listed NR PSHD				X
D-80 Lowman Building 107 Cherry Street	Listed NR PSHD				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-81 Broderick Building (Seattle's Best Coffee) 619 Second Avenue	Listed NR PSHD				X
D-82 Alaska Building 618 Second Avenue	Listed NR PSHD				X
D-85 Pioneer Building,, Pergola, and Totem Pole 606 First Avenue	Listed NR, NHL, PSHD				X
D-86 Butler Garage 601 Second Avenue	Listed NR PSHD				X
D-87 610 Second Avenue	Listed NR PSHD				X
D-88 Hartford Building 600 Second Avenue	Listed NR PSHD				X
D-89 Lyon Building 601 Third Avenue	Eligible				X
D-90 Café Paloma 93 Yesler Way	Listed NR PSHD				X
D-91 Tully's Coffee 99 Yesler Way	Listed NR PSHD				X
D-92 Collins Building 520 Second Avenue	Listed NR PSHD				X
D-93 519 Third Avenue	Listed NR PSHD				X
D-94 512 Second Avenue	Listed NR PSHD				X
D-95 Smith Tower 502 Second Avenue	Listed NR PSHD				X
D-96 Merchant's Café 109 Yesler Way	Listed NR PSHD				X
D-97 Bohemian Nightclub 115 Yesler Way	Listed NR PSHD				X
D-98 Flanagan and Lane 102 Yesler Way	Listed NR PSHD				X
D-99 Metropole Market 423 Second Avenue Extension S	Listed NR PSHD				X
D-100 201 Yesler Way	Listed NR PSHD				X
D-101 Frye Apartments 223 Yesler Way	Listed NR PSHD				X
D-102 408 Second Avenue Extension S	Listed NR PSHD				X
D-103 411 Second Avenue Extension S	Listed NR PSHD				X
D-104 410 Second Avenue Extension S	Listed NR PSHD				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-105 The Last Supper Club 124 S Washington Street	Listed NR PSHD				X
D-106 401 Second Avenue Extension S	Listed NR PSHD				X
D-107 406 Second Avenue Extension S	Listed NR PSHD				X
D-108 400 Second Avenue Extension S	Listed NR PSHD				X
D-109 165 S Washington Street	Listed NR PSHD				X
D-110 McCoys Firehouse 173 S Washington Street	Listed NR PSHD				X
D-111 201 S Washington Street	Listed NR PSHD				X
D-112 Union Gospel Mission 211 S Washington Street	Listed NR PSHD				X
D-113 Matthews and Chesnin Attorneys 219 S Washington Street	Listed NR PSHD				X
D-114 Union Gospel Mission 221 S Washington Street	Listed NR PSHD				X
D-115 313 Second Avenue Extension S	Listed NR PSHD				X
D-116 208 Second Avenue Extension S	Listed NR PSHD				X
D-117 Masins Fine Furniture 220 S Main Street	Listed NR PSHD				X
D-118 Comedy Underground 222 S Main Street	Listed NR PSHD				X
D-119 Seattle Fire Department Fire Prevention 220 Third Avenue	Listed NR PSHD				X
D-120 213 S Main Street	Listed NR PSHD				X
D-121 222 S Main Street	Listed NR PSHD				X
D-122 James Harris Gallery 307 Second Avenue Extension S	Listed NR PSHD				X
D-123 Seattle Lighting Fixture Co. 210 Second Avenue Extension S	Listed NR PSHD				X
D-124 Vacant 208 S Jackson Street	Listed NR PSHD				X
D-125 Leathers/Gourmet Sausage Co./315 S Jackson Street	Listed NR PSHD				X
D-126 King Street Station 301 S Jackson Street	Listed NR PSHD			X	X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-127 Pioneer Square Areaways Underneath Pioneer Square	Eligible NR	X			
D-127a Sinking Ship Garage Areaway	Eligible NR	X			
D-127b Butler Garage Building Areaway 601 Second Ave	Eligible NR		X		
D-127c Broderick Building Areaway 619 Second Avenue	Eligible NR		X		
D-128 Times Square Building Areaway 414 Olive Way	Eligible NR	X			
D-129 Columbia Building Areaway 1516 Second Avenue	Eligible NR	X			
D-131 Pike Place Public Market Historic District	Listed NR				X
D-132 Pioneer Square Historic District	Listed NR			X	
		X			
Downtown/Pioneer Square Segment, Alternative 4.2 - East Side of Second with Crossover					
D-26 Sheridan Apartments 2011 Fifth Avenue	Eligible		X		
D-27 Griffin Building 2005 Fifth Avenue	Potential SLE*		X		
[otherwise same properties as Alignment 4.1, but avoiding demolition of D-33, D-57, and D-67]					
Downtown/Pioneer Square Segment, Alternative 4.3 - Center of Second					
[same properties as Alignment 4.1, but avoiding demolition of D-33 and no adverse effect to D-127b and D-127c]					
Downtown/Pioneer Square Segment, Alternative 4.4 – East Center of Second					
D-26 Sheridan Apartments 2011 Fifth Avenue	Eligible		X		
D-27 Griffin Building 2005 Fifth Avenue	Potential SLE*		X		
[otherwise same properties as Alignment 4.1, but avoiding demolition of D-33, D-57, and D-67]					
Downtown/Pioneer Square Segment, Preferred Alternative					
D-2 Seattle, Chief of the Suquamish Statue/Fifth Avenue, Denny Way, and Cedar Street	Listed NR				X
D-5 2619 Fifth Avenue	Eligible				X
D-7 420 Vine Street	Eligible				X
D-10 Fire Station No. 2 2318 Fourth Avenue	Eligible	X			
D-17 420 Blanchard Street	Eligible				X
D-18 Fifth Avenue Court Apartments 2132 Fifth Avenue	Eligible				X
D-26 Sheridan Apartments 2011 Fifth Avenue	Eligible				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-27 Griffin Building 2005 Fifth Avenue	Potential SLE*				X
D-35 McGraw Square Fifth Avenue/Westlake Avenue/Olive Way/Stewart Street	Seattle Landmark				X
D-37 Securities Building 1904 Third Avenue	Eligible				X
D-33 Centennial Building 1900-1910 Fourth Avenue	Eligible				X
D-34 Times Square Building 414 Olive Way	Listed NR				X
D-36 Mayflower Park Hotel 1630 Fourth Avenue	Eligible				X
D-38 Bon Marche 300 Stewart Street	Eligible				X
D-40 Josephinum Hotel 1900 Second Avenue	Listed NR				X
D-42 Caffè D'Arte 125 Stewart Street	Eligible				X
D-43 Inn at the Market (modern) 1601 First Avenue	Listed NR PPHD	X			
D-46 Triangle Market 1532 Pike Place	Listed NR PPHD				X
D-47 First and Pine Building 1535 First Avenue	Listed NR PPHD				X
D-49 Doyle Building 1527 Second Avenue	Listed NR			X	X
D-50 Haight Building (Second & Pike Building) 211 Pine Street	Eligible				X
D-51 United Shopping Tower/Olympic Tower 217 Pine Street	Listed NR				X
D-54 Corner Market NW corner of First Avenue and Pike Street	Listed NR PPHD				X
D-57 Eitel Building 1511 Second Avenue	Eligible				X
D-59 Economy Market SW corner of First Avenue and Pike Street	Listed NR PPHD				X
D-64 Hadfield Building 1201 Second Avenue	Eligible				X
D-66 Baillargeon Building 1100 Second Avenue	Eligible				X
D-67 Federal Reserve Bank Building 1015 Second Avenue	Eligible		X		

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-68 Exchange Building 821 First Avenue	Eligible				X
D-69 Puget Sound Bank (Bank of California) 815 Second Avenue	Eligible				X
D-72 Seattle Trust and Savings Bank 804 Second Avenue	Eligible				X
D-73 Hong Kong and Shanghai Banking Corporation Clock 720 Second Avenue	Eligible				X
D-74 Foster and Marshall Building 720 Second Avenue	Eligible				X
D-75 Chamber of Commerce Building 215 Columbia Street	Eligible				X
D-76 Metsker Maps 700 First Avenue	Listed NR PSHD				X
D-77 Hoge Building (Carson Boren Home Site) 705 Second Avenue	Listed NR				X
D-78 Dexter Horton Building 710 Second Avenue	Eligible				X
D-79 Mutual Life Building 605 First Avenue	Listed NR PSHD				X
D-80 Lowman Building 107 Cherry Street	Listed NR PSHD				X
D-81 Broderick Building (Seattle's Best Coffee) 619 Second Avenue	Listed NR PSHD				X
D-82 Alaska Building 618 Second Avenue	Listed NR PSHD				X
D-84 Rector Building	Listed NR				X
D-85 Pioneer Building, Pergola, and Totem Pole 606 First Avenue	Listed NR, NHL, PSHD				X
D-86 Butler Garage 601 Second Avenue	Listed NR PSHD				X
D-87 610 Second Avenue	Listed NR PSHD				X
D-88 Hartford Building 600 Second Avenue	Listed NR PSHD				X
D-89 Lyon Building 601 Third Avenue	Eligible				X
D-90 Café Paloma 93 Yesler Way	Listed NR PSHD				X
D-91 Tully's Coffee 99 Yesler Way	Listed NR PSHD				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
D-92 Collins Building 520 Second Avenue	Listed NR PSHD				X
D-93 519 Third Avenue	Listed NR PSHD				X
D-94 512 Second Avenue	Listed NR PSHD				X
D-95 Smith Tower 502 Second Avenue	Listed NR PSHD				X
D-96 Merchant's Café 109 Yesler Way	Listed NR PSHD				X
D-97 Bohemian Nightclub 115 Yesler Way	Listed NR PSHD				X
D-98 Flanagan and Lane 102 Yesler Way	Listed NR PSHD				X
D-99 Metropole Market 423 Second Avenue Extension S	Listed NR PSHD				X
D-100 201 Yesler Way	Listed NR PSHD				X
D-101 Frye Apartments 223 Yesler Way	Listed NR PSHD				X
D-102 408 Second Avenue Extension S	Listed NR PSHD				X
D-103 411 Second Avenue Extension S	Listed NR PSHD				X
D-104 410 Second Avenue Extension S	Listed NR PSHD				X
D-105 The Last Supper Club 124 S Washington Street	Listed NR PSHD				X
D-106 401 Second Avenue Extension S	Listed NR PSHD				X
D-107 406 Second Avenue Extension S	Listed NR PSHD				X
D-108 400 Second Avenue Extension S	Listed NR PSHD				X
D-109 165 S Washington Street	Listed NR PSHD				X
D-110 McCoys Firehouse 173 S Washington Street	Listed NR PSHD				X
D-111 201 S Washington Street	Listed NR PSHD				X
D-112 Union Gospel Mission 211 S Washington Street	Listed NR PSHD				X
D-113 Matthews and Chesnin Attorneys 219 S Washington Street	Listed NR PSHD				X
D-114 Union Gospel Mission 221 S Washington Street	Listed NR PSHD				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects			Visual
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment		
D-115 313 Second Avenue Extension S	Listed NR PSHD					X
D-116 208 Second Avenue Extension S	Listed NR PSHD					X
D-117 Masins Fine Furniture 220 S Main Street	Listed NR PSHD					X
D-118 Comedy Underground 222 S Main Street	Listed NR PSHD					X
D-119 Seattle Fire Department Fire Prevention/220 Third Avenue	Listed NR PSHD					X
D-120 213 S Main Street	Listed NR PSHD					X
D-121 222 S Main Street	Listed NR PSHD					X
D-122 James Harris Gallery 307 Second Avenue Extension S	Listed NR PSHD					X
D-123 Seattle Lighting Fixture Co. 210 Second Avenue Extension S	Listed NR PSHD					X
D-124 Vacant 208 S Jackson Street	Listed NR PSHD					X
D-125 Leathers/Gourmet Sausage Co. 315 S Jackson Street	Listed NR PSHD					X
D-126 King Street Station 301 S Jackson Street	Listed NR PSHD			X		X
D-127 Pioneer Square Areaways	Eligible NR	X				
D-127a Sinking Ship Garage Areaway	Eligible NR	X				
D-127b Butler Garage Building Areaway 601 Second Ave	Eligible NR		X			
D-127c Broderick Building Areaway 619 Second Avenue	Eligible NR		X			
D-128 Times Square Building Areaway 414 Olive Way	Eligible NR	X				
D-129 Columbia Building Areaway 1516 Second Avenue	Eligible NR	X				
D-131 Pike Place Public Market Historic District	Listed NR					X
D-132 Pioneer Square Historic District	Listed NR			X		
SODO/Chinatown ID/PS Segment, Alternative 5.1 - East Side of Third/Utah						
S-58 Markey Machinery Co. 79 S Horton Street	Eligible					X
S-61 Rainier Cold Storage Building A, southeast corner of S Horton Street and Colorado Avenue S	Eligible					X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects			
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual	
SODO/Chinatown ID/PS Segment, Alternative 5.2 or 5.2(s)- West Side of Third/Utah						
S-26 Bank of America 2764 First Avenue S	Eligible				X	
S-58 Markey Machinery Co. 79 S Horton Street	Eligible				X	
S-61 Rainier Cold Storage Building A, southeast corner of S Horton Street and Colorado Avenue S	Eligible				X	
SODO/Chinatown ID/PS Segment, Preferred Alternative						
S-58 Markey Machinery Co. 79 S Horton Street	Eligible				X	
S-61 Rainier Cold Storage Building A, southeast corner of S Horton Street and Colorado Avenue S	Eligible				X	
West Seattle Segment, Alternative 6.1 or 6.1(s)- West Seattle I						
WS-14 Nucor Steel Mill 2424 SW Andover Street	Eligible				X	
W-81 Cherry Creek Furniture 4554 California Avenue SW	Eligible	X				
WS-97 Curious Kidstuff 4740 California Avenue SW	Potential SLE (City of Seattle, Historic Property Inventory, 2001) *				X	
WS-116 Apartment 5202 California Avenue SW	Eligible				X	
WS-117 Apartment 5206 California Avenue SW	Eligible				X	
WS-129 Residence 5440 California Avenue SW	Eligible				X	
WS-143 Farmers Insurance Group 5922 California Avenue SW	Eligible				X	
WS-148 Residence 5933 California Avenue SW	Eligible				X	
WS-151 Residence 5948 California Avenue SW	Eligible				X	
WS-154 Residence 5956-5958 California Avenue SW	Eligible				X	
West Seattle Segment, Alternative 6.2 – West Seattle II						
WS-14 Nucor Steel Mill 2424 SW Andover Street	Eligible				X	
WS-81 Cherry Creek Furniture 4554 California Avenue SW	Potential SLE (City of Seattle, Historic Property Inventory, 2001)*				X	

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
WS-82 Easy Street Records 4302 Alaska Street	Potential SLE (City of Seattle, Historic Property Inventory, 2001)*				X
WS-116 Apartment 5202 California Avenue SW	Eligible				X
WS-117 Apartment 5206 California Avenue SW	Eligible				X
WS-129 Residence 5440 California Avenue SW	Eligible				X
WS-143 Farmers Insurance Group 5922 California Avenue SW	Eligible				X
WS-148 Residence 5933 California Avenue SW	Eligible				X
WS-151 Residence 5948 California Avenue SW	Eligible				X
WS-154 Residence 5956-5958 California Avenue SW	Eligible				X
West Seattle Segment, Alternative 6.3(s) – Delridge North Subsegment					
WS-14 Nucor Steel Mill 2424 SW Andover Street	Eligible			X	X
WS-188 Boysen Apartments 2906 SW Avalon Way	Eligible (Pending)				X
WS-189 The Shack Coffee Shop 2920 SW Avalon Way	Eligible (Pending)				X
West Seattle Segment, Alternative 6.4 – Andover/Yancy Subsegment					
WS-14 Nucor Steel Mill 2424 SW Andover Street	Eligible			X	X
West Seattle Segment, Alternative 6.5 – Genesee Subsegment					
WS-187 Cooper Elementary School 1917 Delridge Way	Eligible (Pending)				X
West Seattle Segment, Preferred Alternative					
WS-14 Nucor Steel Mill 2424 SW Andover Street	Eligible			X	X
WS-81 Cherry Creek Furniture 4554 California Avenue SW	Eligible	X			
WS-97 Curious Kidstuff 4740 California Avenue SW	Potential SLE (City of Seattle, Historic Property Inventory, 2001) *				X
WS-116 Apartment 5202 California Avenue SW	Eligible				X
WS-117 Apartment 5206 California Avenue SW	Eligible				X
WS-129 Residence 5440 California Avenue SW	Eligible				X

Table 4.11-3. Evaluation of Effect and Adverse Effects by Alternative (continued)

Resource/Address	List Status	No Adverse Effect	Adverse Effects		
			Demolition/ Alteration of Property	Isolation/ Alteration of Surrounding Environment	Visual
WS-143 Farmers Insurance Group 5922 California Avenue SW	Eligible				X
WS-148 Residence 5933 California Avenue SW	Eligible				X
WS-151 Residence 5948 California Avenue SW	Eligible				X
WS-154 Residence 5956-5958 California Avenue SW	Eligible				X
WS – 188 Boysen Apartments 2906 SW Avalon Way	Eligible				X
WS-189 The Shack Coffee Shop 2920 SW Avalon Way	Eligible				X

* SLE: Seattle Landmark Eligible (these resources have not yet been formally evaluated by the Seattle Landmarks Board).

NHL: National Historic Landmark

^a Demolition would occur with Howe 1A(Blaine) Station

^b Demolition would occur with Fifth/Stewart 1 (Northwest) station

^c Visual adverse effect only would occur with Fifth/Stewart 2 (Virginia) station; demolition not required

^d Visual effect would occur with Pike 1 (West), Option B

^e Demolition would occur with Pike 1 (West), Option A

In most cases, the alternatives examine alignment and station alternatives along the same streets, placing them near the same sets of historic resources in each segment. The majority of adverse effects to historic resources from the Green Line involve visual effects created by the placement of a modern elevated Green Line structure or station nearby. An adverse effect to the resource could vary in magnitude depending on proximity to the Green Line (for instance, by being across the street rather than directly in front of a resource) and the existing visual context. This EIS analysis has assumed conservatively large stations, and the actual station development could be smaller with less visual and construction footprint impacts. A limited number of resources could be demolished or substantially altered by the Green Line, causing an adverse effect, but in cases where this could be avoided (such as by choosing a different station alternative), the resource would still experience an adverse visual effect because the modern Green Line structure would be introduced nearby. Structural vibration effects from Green Line construction to adjacent properties constitute potential effects to historic structures. The construction vibration threshold criterion for historic buildings is 100 VdB for fragile buildings and 95 VdB for extremely fragile buildings (which include historic brick buildings with a high risk of cracking and the Pioneer Square Arterials). More information regarding historic resources and construction vibration effects from pile driving based on individual building descriptions, distances to the alignment, sensitivity ratings, and construction vibration activities, are described further in Section 4.17, Construction; Section 4.7, Noise and Vibration; and the Section 106 Cultural Resources Report (Appendix NN). With appropriate construction techniques and monitoring, construction vibration impacts can be avoided.

Other criteria for evaluation of adverse effects for historic resources, including loss of access, change of function, or neglect, would not result in long-term adverse effects because the setting for the resources is a highly urbanized area along or near high-use transportation corridors. Access to the properties would be maintained for the long term; and noise, traffic, and other changes resulting from the project (including the adverse visual effects) would not be likely to result in a change of function. Although the project's visual effects and change of setting result in an adverse effect for many of the resources in the APE,

historic resources in station areas could also benefit from the long-term improvement in access, which would increase economic vitality in surrounding areas, as discussed in Section 4.4, Economics.

A number of comments to the Draft EIS asked for additional information regarding the monorail train's "dynamic envelope" and what that would mean for potential repairs and maintenance of buildings along the Green Line route. The train's dynamic envelope is the furthest area in which the monorail train would ever be located even under worst case conditions. Under normal operating conditions, the monorail train would travel along its normal "static envelope" or normal operating envelope. Under extreme conditions, however, the train could vary from this normal operating condition and be located closer to the property line and building façade. This limit on where the train would ever be located along the guideway, even under the most extreme conditions, is called the "dynamic envelope." The minimum, specified distance from the dynamic envelope to property lines or building facades would be five feet under current specifications, which have been recommended by the Fire and Life Safety Committee (composed of SMP systems and facilities engineers and experts from Washington Department of Transportation and the City of Seattle Fire, Police, Transportation, DPD, and other departments) as a design minimum clearance. This would occur in the 12 to 14-foot area along which the monorail train would pass the building, not for the entire building height.

All buildings along the line would still be able to wash windows and maintain their buildings. All common window washing equipment would be able to operate within the five-foot distance, including ladder work (under 30 feet), rope harnesses, or buckets. For more involved maintenance, such as tuck pointing older brick buildings, typical scaffolding systems are only three to four feet wide and many common scaffolding systems are even narrower. Even with a small space between the scaffolding and the building, it is easily feasible to work within the area of five feet from the building. A recent example of this is the Fisher Building, which was constructed adjacent to the existing Seattle Center monorail at the southwest corner of Fifth Avenue N and N John Street. That building was constructed even closer to the dynamic envelope of the existing monorail trains than the minimum distances proposed from building facades to the Green Line monorail trains. The building was successfully constructed, and is currently being successfully cleaned and maintained. A letter from Fisher Media Services Company, attesting to this, is included in Appendix MM.

Commenters also wanted to know how far from buildings that static envelope, or normal operating location, would be located. This would depend on the train manufacturer selected because the taller and wider trains have greater differences between their static envelope to their dynamic envelope. Generally, however, the minimum distance to a train would be six to six and one-half feet from the property line or façade. Readers should note that, for a given column location, it is possible to move guidebeams slightly further from buildings by offsetting the guidebeams with respect to the foundation beams. The tradeoff for offset guidebeams (also called eccentric columns) is larger foundation beams in the sidewalk or right-of-way. Another method to locate trains further from buildings could be by using the single beam configuration, which is SMP's Preferred Alternative in the lower-scale areas of Ballard and along California Avenue SW in West Seattle.

Potential mitigation measures for both short-term and long-term effects are discussed in this section. Specific measures to avoid, minimize, or mitigate adverse effects on historic, archaeological, or ethnographic resources are included in Chapter 5 (Mitigation) of this Final EIS and are also discussed in Appendix NN (Cultural Resources). These mitigation measures will be included in a Memorandum of Agreement prior to the Coast Guard Record of Decision, which will include a binding commitment to such mitigation.

4.11.3.1 Long-Term Impacts

Segment 1: Ballard Segment

Alternative 1.1 or 1.1(s) - West Side of 15th

Four historic resources determined eligible for the NRHP and one historic resource (Ballard Bridge) listed in the NRHP are located along Alternative 1.1 or 1.1(s). Visual impacts from the elevated structure nearby would result in an adverse effect to a residence (B-60), apartments (B-114), Mike's Chili Parlor (B-131), and the Ballard Bridge (B-140). For the Ballard Bridge (B-140), the adverse effect also includes alteration of the surrounding environment by the introduction of a new bridge for the Green Line. Alternative 1.1 would have an adverse effect on Brekke Co. Steel Fabricators (B-132) due to the proximity of the Green Line. None of the station alternatives along this alignment would have an adverse effect on historic resources.

Alternative 1.2 - Center of 15th

Alternative 1.2 would have adverse visual effects on residence (B-60), apartments (B-114), Mike's Chili Parlor (B-131), and the Ballard Bridge (B-140). The adverse effect to Mike's Chili Parlor (B-131) would be greater than with Alternative 1.1 or 1.1(s) because the placement of the elevated structure to the west of the resource would be closer and would increase the change in character to the resource's setting. This would include increased isolation because affected properties would then be located between 15th Avenue NW's approach to the Ballard Bridge and the new Green Line guideway structure. Construction adjacent to the Ballard Bridge (B-140) would also result in an adverse effect due to isolation/alteration of the surrounding environment. As with Alternative 1.1/1.1(s), none of the station alternatives would have an adverse effect on historic resources.

Ballard Preferred Alternative

Within the Ballard Segment of the Preferred Alternative there are four buildings that are eligible for the NRHP and the Ballard Bridge, which is listed in the NRHP. Adverse visual effects would occur to the Brekke Co. Steel Fabricators (B-132), an apartment building (B-114), a residence (B-60), and Mike's Chili Parlor (B-131). Construction adjacent to the Ballard Bridge (B-140) would result in an adverse visual effect and isolation/alteration of the surrounding environment. None of the station alternatives along this alignment would have an effect on historic resources.

The Preferred Alternative would have the same adverse effects to five historic resources as alternative 1.1 or 1.1(s). Whereas Alternative 1.2 would have adverse effects on four historic resources. Although Alternative 1.2 would have adverse effects on fewer resources than the Preferred Alternative, it would have greater adverse effects on Mike's Chili Parlor (B-131), causing isolation/alteration of surrounding environment. All alternatives would cause isolation/alteration of surrounding environment to the Ballard Bridge (B-140).

Segment 2: Interbay/Magnolia Segment

Alternative 2.1 or 2.1(s) - West Side of 15th/Center of Elliott

Two historic residences (I-25 and I-26) would experience adverse effects because Alternative 2.1/2.1(s) would pass over and potentially demolish all or part of the properties causing alteration of the property. If the West Bridge approach is selected (Alternative 2.1.1), there would be adverse visual effects and isolation/alteration of the surrounding environment on a storage building at Fishermen's Terminal (I-1C), while the Far West Bridge approach (Alternative 2.1.2) would avoid the effect. Six resources would be

adversely affected by the visual changes related to the elevated guideway structure nearby, including Tsubota Steel and Pipe (I-52), the Ace Tank complex (I-72, I-73, I-74), Wilson Machine Works (I-80), and Phillips Scale Co. (I-86). The Green Line would be consistent with the industrial context and utilitarian architecture of the neighborhood. There would be no adverse effect on Leibold Communications Inc. (I-66).

Only one station alternative would have an effect on historic properties.

- **Howe 1 A (Blaine):** the false-front wood-frame Tsubota Steel and Pipe Building (I-52) would be demolished under this alternative.

Alternative 2.2 - Center of 15th/West Side of Elliott

Alternative 2.2 would avoid adverse effects to the two historic residences affected by Alternative 2.1. It would have adverse visual effects to the following six historic properties along 15th Avenue W and Elliott Avenue W, also discussed for Alternative 2.1: Tsubota Steel and Pipe (I-52), Ace Tank complex (I-72, I-73, I-74), Wilson Machine Works (I-80), and Phillips Scale Co. (I-86). In addition, one historic residence (I-19) and the Leibold Communication Inc. (I-66) are located within the APE for this alternative. There would be no adverse effect on a residence (I-19) and Leibold Communications Inc. (I-66) (Table N-2).

Only one station alternative within this alignment alternative would have any effects:

- **Dravus 2 (15th):** A residence (I-19) would be affected through adverse visual effects from construction of the guideway nearby.

Operations Center C-1 - Interbay

No historic resources would be affected by this alternative.

Interbay/Magnolia Preferred Alternative

Ten buildings within the Preferred Alternative APE have been determined eligible for the NRHP. Construction of this alternative would result in visual adverse effects to six buildings including the Tsubota Steel and Pipe Building (I-52), three Ace Tank buildings (I-72, I-73, and I-74), Wilson Machine Works (I-80), and Phillips Scale Co. (I-86). Under this alternative the guideway would pass over and potentially demolish all or part of residences (I-25 and I-26) causing alteration of the property. The storage building at Fishermen's Terminal (I-1C) would be affected by both isolation/alteration of the surrounding environment and adverse visual effects. There would be no adverse effect to Leibold Communications Inc. (I-66).

Two station alternatives would have an effect on historic properties:

- **Howe 1 A (Blaine):** the false-front wood-frame Tsubota Steel and Pipe building (I-52) would be demolished under this alternative.
- **Dravus 1 B:** Under this alternative, the guideway would pass over and potentially demolish all or part of residences (I-25 and I-26) causing alteration of the property.

The Preferred Alternative would have the same adverse effects to ten historic resources as Alternative 2.1, if the West Bridge Connection were used. If Alternative 2.1 used the Far West Bridge Connection, the alternative would avoid isolation/alteration of property to the Storage building at Fisherman's Terminal (I-1C) and would have adverse effects on only nine historic resources. The Preferred Alternative would have an adverse effect on ten historic resources, compared to the six historic resources that would be adversely affect by Alternative 2.2. The adverse effects of Alternative 2.2 would all be visual, while the Preferred Alternative would demolish/alter the property of three resources (I-25, I-26, and I-52), cause

isolation of the environment to one resource (I-1C), and create visual adverse effects for five other resources (I-72, I-73, I-74, I-80, and I-86).

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Alternative 3.1 - Seattle Center/Republican

Five significant historic resources would experience adverse effects with Alternative 3.1. The guideway approach to the Queen Anne 1 (North) station could require the Green Line guideway to pass over the Dalmasso Apartments (SC-8), resulting in an adverse effect due to alteration of property. The existing Seattle Center Monorail Terminal Office and Track (SC-16) would also be demolished, all or in part, including the track extending to Westlake Center. Options to retain a portion of the original monorail guideway through EMP (Alternative 3.1.2) would still involve an adverse effect to the resource because other portions would still be demolished. Introduction of the Green Line's elevated guideway in the immediate vicinity of historic resources would create visual effects that would have an adverse effect to 7 Queen Anne Avenue N (SC-7), Memorial Stadium (SC-22), and the Center House - Seattle Center (SC-15). This alternative would have no adverse effect on three resources: Queen Anne Apartments (SC-13), Space Needle (SC-31), and Seattle Center Fountain (SC-32). The following station alternatives would have an effect on historic properties:

- **Belltown Stations 1, 1A, and 2:** These three station alternatives would have adverse visual effects on 420 Blanchard Street (D-17) and the Fifth Avenue Court Apartments (D-18).

Alternative 3.2 – Mercer

Four resources eligible for listing in the NRHP would be adversely affected by Alternative 3.2. As with Alternative 3.1, the guideway approach to the Queen Anne 1 (North) station could require the Green Line to pass over the Dalmasso Apartments (SC-8) causing alteration of property, an adverse effect. The guideway to the station would also result in visual effects that would change the setting and cause adverse effects to 7 Queen Anne Avenue N (SC-7). The elevated structure turning from Mercer Street to Fifth Avenue N would adversely affect the Auditorium Apartments (SC-20) by creating visual effects that would alter its setting. With Alternative 3.2, there would be an option to retain the Fifth Avenue guideway of the existing Seattle Center Monorail Terminal Office and Track System (SC-16), or the Fifth Avenue guideway could be demolished; both options would involve adverse effects. The new Green Line directly beside the existing monorail would adversely affect its setting, although its function could potentially continue. The alignment would avoid Alternative 3.1's adverse visual effects to the Memorial Stadium (SC-22) and the Center House (SC-15). Alternative 3.2 would have no adverse effect on the Queen Anne Apartments (SC-13). Under this alternative, the Seattle Center Queen Anne 1 and 1A (North) stations would have the same effects as listed under Alternative 3.1. This alternative also includes the Belltown 1(Center-West), 1A(Center-West) and 3(West) station alternatives that would have the same effect as the Belltown station options listed under Alternative 3.1.

Alternative 3.3 - Thomas

The Thomas Street alignment alternative would cause adverse effects to four significant historic resources, all of which are eligible for listing in the NRHP. With a station to the southwest of Key Arena (Seattle Center/Queen Anne 2), this alternative would avoid demolition of Dalmasso Apartments (SC-8), but an adverse visual effect would still result due to the guideway and station's close proximity to the apartments, as well as to 7 Queen Anne Avenue N (SC-7). The route through the Seattle Center would cross directly to the south of the Center House (SC-15) and Space Needle (SC-31) creating visual effects that would be considered adverse. It would also remove the existing Seattle Center Monorail (SC-16), as was described with Alternative 3.1, although the alignment itself might require removal of only that portion extending down Fifth Avenue. There would be no adverse effect the Seattle Center Fountain (SC-

32). The Seattle Center/Fifth and Broad and Belltown station alternatives for this alignment would not result in additional adverse effects to historic resources. The Belltown station alternatives for this alignment would have adverse visual effects on 420 Blanchard Street (D-17) and the Fifth Avenue Court Apartments (D-18).

Alternative 3.5 - Second/Denny

Two of the same historic resources as the resources identified under Alternative 3.2 are located in the APE of Alternative 3.5 (Second/Denny): 7 Queen Anne Avenue N (SC-7) and the Dalmasso Apartments (SC-8) (Table N-3). The construction of this alternative would adversely affect the Dalmasso Apartments (SC-8) and 7 Queen Anne Avenue N (SC-7) through visual effects and introduction of new construction (Table N-2), including the Seattle Center/Queen Anne 2 (South) station. The Seattle Center Monorail (SC-16) would be demolished under this alternative. The Belltown station alternatives for this alignment would have adverse visual effects on 420 Blanchard Street (D-17) and the Fifth Avenue Court Apartments (D-18).

Queen Anne/Seattle Center/Belltown Preferred Alternative

The Preferred Alternative would have adverse effects on five resources that have been determined eligible for the NRHP. The alternative would have adverse visual effects on an apartment building (SC-7), the Seattle Center House (SC-15) and Memorial Stadium (SC-22). Construction of this alternative would result in the demolition of the Monorail Terminal, Office, and Track (SC-16) located in Seattle Center. The Green Line guideway would pass over the Dalmasso Apartments (SC-8) creating an adverse effect by altering the property. There would be an effect, but no adverse effect on the Queen Anne Apartments (SC-13) and the Space Needle (SC-31), and Seattle Center Fountain (SC-32). The following station alternatives would have an effect on historic properties:

- **Belltown 1A(Center-West):** This alternative would have adverse effects on 420 Blanchard Street (D-17) and the Fifth Avenue Court Apartments (D-18).

The Preferred Alternative would have the same adverse effects to five resources as Alternative 3.1. Alternatives 3.2 and 3.3 would each adversely affect four resources and Alternative 3.5 would have adverse effects on only three resources. The Monorail Terminal, Office and Track (SC-16) would be demolished under all of the alternatives for this segment. Alternatives 3.1, 3.2, and the Preferred Alternative would each result in alteration of property for the Dalmasso Apartments (SC-8), over which the guideway would be constructed.

Segment 4: Downtown/Pioneer Square Segment

Alternative 4.1 - West Side of Second

Without appropriate mitigation, Alternative 4.1 would have adverse effects on up to 84 historic resources identified along this alignment. Up to five historic resources would be adversely affected by demolition/alteration of property, two buildings and the Pioneer Square Historic District would be adversely affected by isolation/alteration of the surrounding environment, no adverse effects would occur to four historic resources and the remaining resources would have adverse visual effects.

The historic resources that could be demolished under this alternative include the Centennial Building (D-33), Eitel Building (D-57), and Federal Reserve Bank Building (D-67). Without using avoidance as mitigation, the Broderick Building Areaway (D-127c) and Butler Garage Areaway (D-127b) could be altered due to the placement of monorail footings along the exterior walls of the areaways. Isolation/alteration of the surrounding environment would affect the Pioneer Square Historic District (D-132), Doyle Building (D-49), and King Street Station (D-126). See Appendix NN for illustrations

showing the proximity of the guideway to these resources. Fire Station No. 2 (D-10) and three historic areaways, including the Sinking Ship Garage Areaway (D-127a), Times Square Building Areaway (D-128), and Columbia Building Areaway (D-129) would have no adverse effects from this alternative.

Long-term visual effects caused by the introduction of a new modern element would adversely affect historic resources along this alignment. The visual effects would be related to the introduction of the elevated structure or stations, altering views of the buildings and/or substantially changing the character of their settings. In the cases where a different station siting option could potentially avoid the demolition of a historic resource, the resource would still be adjacent to the guideway and would experience an adverse visual effect. Without considering design as mitigation, the Green Line columns and guideways may block views of significant architectural details such as cornices, moldings, pilasters, and window and door openings. Without considering design as mitigation, the Green Line columns and guideways would block some views of significant architectural details such as cornices, moldings, pilasters, and window and door openings. The height of the guideways would also block views of some of the decorative belt coursing located above the second story of some early twentieth-century historic buildings from some locations within the Downtown Segment. Visual simulations were prepared for many buildings in the Downtown Segment and are included in the Section 106 Cultural Resources Report (Appendix NN).

King Street Station (D-126) is located on the southern edge of the Pioneer Square Historic District. North of King Street Station is the new King County Building, which currently contributes to the separation of the station from the rest of the Pioneer Square Historic District. The operation of the Monorail line north of King Street Station would further isolate this historic resource from the rest of the historic district. Although the operation of the Green Line, a linear rail transportation system, adjacent to the historic King Street Station is a modern intrusion in the Pioneer Square Historic District its use correlates closely with the area's historic railroad systems and will support the King Street Station's ongoing rail function.

The historic resources affected by Alternative 4.1 include the Pike Place Market and Pioneer Square historic districts and the following seven properties individually listed in the NRHP: Seattle, Chief of the Suquamish Tribe Statue (D-2), Times Square Building (D-34), Josephinum Hotel (D-40), Doyle Building (D-49), United Shopping Tower/Olympic (D-51), and Hoge Building (D-77). The Pioneer Building, Pergola and Totem Pole (D-85) are also listed as an ensemble in the NRHP and as a National Historic Landmark and would be affected by the change in visual context. Fifty historic resources are listed in the NRHP including as part of the Pike Place Market and Pioneer Square historic districts (see Table 1, Appendix NN). Twenty-five other affected resources have been determined eligible for listing in the NRHP (Table 4.11-2): 2619 Fifth Avenue (D-5), 420 Vine Street (D-7), 420 Blanchard Street (D-17), Fifth Avenue Court Apartments (D-18), Sheridan Apartments (D-26), Securities Building (D-37), Mayflower Park Hotel (D-36), Centennial Building (D-33), Bon Marche (D-38), Caffé D'Arte (D-42), Haight Building (D-50), Eitel Building (D-57), Hadfield Building (D-64), Baillargeon Building (D-66), Federal Reserve Bank Building (D-67), Exchange Building (D-68), Puget Sound Bank (D-69), Seattle Trust and Savings Bank (D-72), Hong Kong and Shanghai Banking Corporation Clock (D-73), Foster and Marshall Building (D-74), Chamber of Commerce Building (D-75), Dexter Horton Building (D-78), Lyon Building (D-89), Pioneer Square Areaways (D-127), Times Square Building Areaway (D-128), and Columbia Building Areaway (D-129).

In addition, the Griffin Building (D-27) is eligible to be a Seattle City Landmark.

The effects of the station alternatives for Alternative 4.1 include:

- **Fifth and Stewart 1 (Northwest):** The Centennial Building (D-33) would be demolished, and nearby historic properties, including the Securities Building (D-37), Mayflower Park Hotel (D-36), Times Square Building (D-34), and the Bon Marche (D-38), would be adversely affected through visual effects and the change in setting related to the removal of the Centennial Building

and the introduction of the new Green Line guideway and the station. The Times Square Building Areaway (D-128) would not be adversely affected by the construction of this station.

- **Fifth and Stewart 1A (West):** This alternative would have an adverse visual effect on the Sheridan Apartments (D-26), Griffin Building (D-27), and Times Square Building (D-34). The alternative would have no adverse effect on the Times Square Building Areaway (D-128).
- **Fifth and Stewart 2 (Virginia):** This alternative would avoid demolition of the Centennial Building. If this station alternative were selected instead of the Fifth and Stewart 1, the Green Line guideway along Stewart Street would cause adverse visual effects to the Centennial Building (D-33), the Securities Building (D-37), the Mayflower Park Hotel (D-36), and the Bon Marche (D-38).
- **Fifth and Stewart 2A (Virginia Center):** This alternative would have an adverse visual effect on the Sheridan Apartments (D-26) and the Griffin Building (D-27).
- **Pike 1 (West) A and B:** The station options differ primarily in the location of the station footprint. Pike 1 (West) A would demolish the Eitel Building; Pike 1 (West) B, the Preferred Alternative, would not. The station and adjacent guideways for both options would cause visual and change of setting effects to adjacent historic properties. Under Option A the Doyle Building (D-49), and Haight Building (D-50) would experience adverse visual effects. There would be an effect, but no adverse effect to the Columbia Building Areaway (D-129). Option B, while not demolishing the Eitel Building, would have adverse visual effects to the Pike Place Public Market Historic District (D-131), Doyle Building (D-49), Haight Building (D-50), Corner Market (D-54), Economy Market (D-59), and First and Pine Building (D-47). The Doyle Building would also experience isolation/alteration to the surrounding environment.
- **Madison 1 (West):** The Federal Reserve Bank Building (D-67) property would be acquired and demolished with this station option. There would also be an adverse visual effect on the Baillargeon Building (D-66).
- **Yesler 1 (West):** This station option would have an adverse effect on the Smith Tower (D-95), which would be directly across Second Avenue. The construction of the Green Line station adjacent to the Smith Tower will introduce a modern structure to the Pioneer Square Historic District and obscure the view of the front elevation of the building. The station would be about the equivalent of a four-story building. However, the existing non-contributing parking garage, which already obscures this, would be demolished. Due to the demolition of that intrusive structure, there would be an offsetting positive effect on the surrounding buildings. The potential advantages to demolishing the Sinking Ship Garage would include other benefits to the neighborhood, including the creation of a more inviting public space, potential new physical and visual connections to Pioneer Square Park, as discussed in Section 4.5, Visual Quality and Aesthetic Resources, and potential development that is compatible with the Pioneer Square Historic District. There would be no adverse effect on the Sinking Ship Garage Areaway (D-127a).

Alternative 4.2 - East Side of Second with Crossover

Although Alternative 4.2 involves several different station options and would be on the opposite side of Second Avenue than Alternative 4.1 from Stewart Street to south of Marion Street, the overall number of resources adversely affected is similar, at 81. With the Fifth and Stewart 3 (Lenora) station, the alternative would avoid the demolition of the Centennial Building (D-33), but would instead require demolition of the Sheridan Apartments (D-26) and Griffin Building (D-27). Similar to Alternative 4.1, the Broderick Building Areaway (D-127c) and Butler Garage Areaway (D-127b) would be altered due to the placement of monorail footings along the exterior walls of the areaways.

Compared to Alternative 4.1, the alignment of Alternative 4.2 on the east side of Second Avenue would lessen visual effects for historic buildings on the west side (such as the Exchange Building), while increasing the effects to resources on the east side, but in all cases, the presence of the Green Line structure on Second Avenue would still remain an adverse effect to the adjacent historic resources. Alternative 4.2 would cross over Second Avenue south at Marion Street to follow the west side of Second Avenue and use the Yesler 1 station. This would avoid placing the Green Line guideway or a station immediately beside the Smith Tower (D-95), although as with Alternative 4.1, an adverse visual effect would result. Please refer to Section 4.5, Visual Quality and Aesthetic Resources, for more information. This alternative would also use the following additional stations.

- **Fifth and Stewart 3 (Lenora):** This alternative would have an adverse visual effect on demolish the Sheridan Apartments (D-26) and the Griffin Building (D-27).
- **Pike 2 (East):** This alternative would have an adverse visual effect on the Eitel Building (D-57), Doyle Building (D-49), Haight Building (D-50) and no adverse effect on the Columbia Building Areaway (D-129).
- **Madison 2 (East):** This alternative would adverse visual effects on the Federal Reserve (D-67), Exchange Building (D-68), and Puget Sound Bank (D-69).

Alternative 4.3 - Center of Second

Except for the avoidance of demolition of historic properties for Alternative 4.1 stations, an alignment along the center of Second Avenue would adversely affect a similar number of historic resources, 79. The guideway in the center of Second Avenue could avoid placing a structure immediately in front of the historic buildings fronting Second Avenue, but it would more greatly restrict views down Second Avenue because the supporting structures for stations would extend from the sides to the middle of Second Avenue. The guideways would also be horizontally arranged, compared to the vertical arrangement that either Alternative 4.1 or 4.2 would use, which could have somewhat different impacts on street level views of upper floors of buildings and their architectural details. However, the introduction of the Green Line guideway and stations on Second Avenue would remain a substantial change to the setting for these historic resources, and visual effects, including partial obstruction of views of the buildings, would still occur and would be an adverse effect.

Alternative 4.3 station alternatives include Fifth and Stewart 2 (Virginia), which has effects as described in Alternative 4.1. The effects of the other stations include view blockage because the center mezzanine stations would be relatively large and would involve a greater intrusion into the street right-of-way. There would be greater adverse effects on views than with the stations associated with either Alternative 4.1 or 4.2:

- **Pike 3 (Center):** The presence of the station and adjacent guideway at this location would cause adverse visual effects for the Doyle Building (D-49), Haight Building (D-50), and United Shopping Tower/Olympic Tower (D-51) and would require the demolition of the Eitel Building (D-57)
- **Madison 3 (Center):** This alternative would require the demolition of the Federal Reserve Building (D-67) and create adverse visual effects to the Baillargeon Building (D-66).
- **Yesler 3 (Center):** With a station over Second Avenue, this alternative would be more prominent than Yesler 1 (West), placing the station structure and supporting structures closer to Smith Tower. The introduction of the station and guideway on Second Avenue near Smith Tower and into the Pioneer Square Historic District would be an adverse visual effect. This alternative would have no adverse effect on the Sinking Ship Garage Areaway (D-127).

Alternative 4.4 – East Center of Second

The impacts under this alternative would be similar to those under Alternative 4.2. This alternative would include the Fifth and Stewart 3 (Lenora) station discussed under Alternative 4.2 and the previously discussed Yesler 1 (West) station. Under this alternative the Columbia Building Areaway (D-129) would not be adversely affected.

The effects of additional station alternatives for Alternative 4.4 include:

- **Pike 2A (East Center):** This station option will have adverse visual effects on the Eitel Building (D-57).
- **Madison 2A(East Center):** This alternative would adverse visual effects on the Federal Reserve (D-67), Exchange Building (D-68), and Puget Sound Bank (D-69).

Downtown/Pioneer Square Preferred Alternative

This alternative would have adverse visual effects on 84 historically significant resources. The Pioneer Square Historic District, Doyle Building (D-49) and King Street Station (D-126) would be adversely affected due to the isolation/alteration from the surrounding environment. The Federal Reserve Building (D-67) would be demolished and the Broderick Building Areaway (D-127c) and Butler Garage Areaway (D-127b) would be altered by the placement of a guideway footing on the areaways' exterior walls. Four resources would have no adverse effects, including Fire Station No. 2 (D-10), and three areaways (D-127, D-128 and D-129). This alternative would use the previously discussed Fifth and Stewart 2A (Virginia Center), Pike 1 (West) B, Madison 1 (West), and Yesler 1 (West) stations.

The Preferred Alternative (4.1) would have similar adverse effects as Alternatives 4.2, 4.3 and 4.4 with visual effects on more buildings. The adverse effects under Alternative 4.1, however, include options to demolish two more buildings (D-33 and D-57) than under the Preferred Alternative. Alternative 4.3 would have the fewest number of demolitions.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Alternative 5.1 - East Side of Third/Utah

Alternative 5.1 would involve visual effects, including the introduction of the Green Line structure near a historic resource determined eligible for listing in the NRHP. Markey Machinery Co. (S-58) on S Horton Street would experience adverse visual effects from the placement of the Green Line structure in front of and above it. The Rainier Cold Storage Building A (S-61) would also experience an adverse visual effect. Because the building's setting would be in the Port of Seattle industrial area, would not be immediately adjacent to the new Green Line structures, and would be surrounded by port and transportation uses, the degree of change in setting it would experience would be lower than Markey Machinery Co. No historic resources are located within the APE of the station alternatives.

Alternative 5.2 or 5.2(s) - West Side of Third/Utah

Under this alignment alternative, three historic resources would experience adverse effects. Markey Machinery Co. (S-58) would experience adverse visual effects as described for Alternative 5.1, and a short portion of the route along First Avenue S would place the Green Line structure near the Bank of America (S-26). The effects would involve visual effects and change of setting related to the introduction of the Green Line structure near the resources. The moderate effect on Rainier Cold Storage Building A (S-61) would be as was described for Alternative 5.1. Station alternatives would not have adverse effects on historic resources.

Operations Center C-2 - SODO

No historic resources are located in the APE of this Operations Center location.

SODO/Chinatown International District/Pioneer Square Preferred Alternative

This alternative would have the similar adverse effects as Alternative 5.2. The Markey Machinery Co. (S-58) and the Rainier Cold Storage Building A (S-61) would both have adverse visual effects due to construction of the guideway.

The Preferred Alternative would have the same adverse effect to historic resources as Alternative 5.1. This alternative would avoid the adverse effect to the Bank of America Building (S-26), which would occur under alternative 5.2.

Segment 6: West Seattle Segment

Alternative 6.1 - West Seattle I

Nine historic resources would experience adverse effects with Alternative 6.1. Curious Kidstuff (WS-97), a property previously identified as eligible for listing as a Seattle Landmark (City of Seattle, Historic Property Inventory, 2001), and three other properties determined eligible for listing in the NRHP, including Farmers Insurance Group (WS-143), two apartment buildings (WS-116 and WS-117) and four residences (WS-129, WS-148, WS-151 and WS-154), are along California Avenue SW and would experience adverse visual effects. This alternative would have no adverse effect on the Cherry Creek Furniture Building (WS-81), which would be located one block from the proposed guideway. Nucor Steel Mill (WS-14) would experience adverse visual effects due to the introduction of the elevated Green Line structure departing from the West Seattle Bridge and passing to the east and substantially above the property to the Delridge 1 station, which would also be highly visible. Avalon 1 (Center), Alaska Junction 1 (42nd/Edmunds), Alaska Junction 1A, Morgan Junction 1 (West), and Morgan Junction 1A station options would not affect historic properties.

Alternative 6.2 – West Seattle II

Ten historic resources would experience adverse effects with Alternative 6.2. All adverse effects would be visual. The affected properties include three properties along California Avenue SW: Farmers Insurance Group (WS-143), two apartments (WS-116 and WS-117) and four residences (WS-129, WS-148, WS-151 and WS-154). With the route along Alaska Street, Easy Street Records (WS-82) and Cherry Creek Furniture (WS-81) would experience adverse visual effects due to the introduction of the Green Line structure. The Alternative 6.2 alignment would cross into the Nucor Steel Mill (WS-14) property and the Delridge 2 (Andover) station on the property. There would be an adverse visual effect to the Nucor Steel Mill due to the construction of the station on a portion of the property, but the access to and function of the mill is not expected to be affected. The stations at Delridge 2 (Andover), Avalon 2A (35th), Alaska Junction 2 (44th/California), and Morgan Junction 2 (Center) would not affect historic resources.

Alternative 6.3(s) – Delridge North Subsegment

Three historic properties would be affected by this alternative. The properties include the Nucor Steel Plant (WS-14), the Boysen Apartments (WS-188), and the Shack Coffee Shop (WS-189). These properties would all have adverse visual effects.

Only one station alternative would have an effect on historic properties:

- **Delridge 3 (Nucor):** Construction of a station at the Nucor Steel Plant (WS-14) would result in the isolation/alteration of this resource from the surrounding environment, which consists of freeway ramps, a fire station, and a scrap yard.

Alternative 6.4 –Andover/Yancy Subsegment

The Nucor Steel Plant (WS-14) would have adverse visual effects due to this alternative and isolation/alteration of the surrounding environment. No historic resources are located within the APE of this station alternative.

Alternative 6.5 -- Genesee Subsegment

The Cooper Elementary School (WS-187) would have adverse visual effects due to this alternative. No historic resources are located within the APE of this station alternative.

West Seattle Preferred Alternative

Under this alternative the Nucor Steel Mill (WS-14), Farmers Insurance Group (WS-143), Curious Kid Stuff (WS-97), the Boyson Apartments (WS-188), the Shack Coffee Shop (WS-189) two apartments (WS-116 and WS-117) and four residences (WS-129, WS-148, WS-151, and WS-154) would have adverse visual effects. The Cherry Creek Furniture (WS-81) building is also within the APE for this alignment, but would have no adverse effects. No historic resources are located within the APE of this station alternative. Construction of the guideway directly adjacent to the north side of the Nucor Steel Mill property would result in isolation/alteration of the surrounding environment.

Construction of a station at the Nucor Steel Plant (WS-14) would also result in the isolation/alteration of this resource from the surrounding environment, which consists of freeway ramps, a fire station, and a scrap yard.

While Alternatives 6.1 and 6.2 would have adverse visual effects on nine resources, the Preferred Alternative would have adverse visual effects on eleven historic buildings or structures. This alternative would also create isolation/alteration of surrounding environment for the Nucor Steel Plant (WS-14).

No Action Alternative

Under the No Action Alternative, transportation improvements would be limited to those included in the future Seattle development projects, including transportation improvements and neighborhood redevelopment. There would be no long-term adverse effects to archaeological or historic resources from the Green Line.

4.11.4 Mitigation

Potential mitigation measures that were discussed by the City of Seattle, OAHP, and SMP are described below. More specific measures to avoid, minimize, or mitigate adverse effects on historic, archaeological or ethnographic resources are included in Chapter 5 (Mitigation Program) of this Final EIS and are also discussed in Appendix NN (Cultural Resources). These mitigation measures will be included in a Memorandum of Agreement (MOA) prior to the Coast Guard Record of Decision, which will include a binding commitment to such mitigation.

4.11.4.1 Archaeological Resources

Measures to mitigate adverse effects to significant unknown archaeological resources have been identified. Mitigation measures are based on estimated probabilities that buried archaeological resources may be identified during construction excavation for columns, bridge piers, stations, and the Operations Center. Mitigation measures were developed to protect archaeological resources that may be present and may be significant while minimizing construction downtime. SMP will coordinate with the Coast Guard, OAHP, City of Seattle, and Tribes to develop an Archaeological Treatment Plan for archaeological resources and traditional cultural properties prior to construction. This Archaeological Treatment Plan will be codified in the MOA.

4.11.4.2 Historical Resources

Measures to mitigate effects to historic resources are presented in this section. As with the effect analysis, separate mitigation measures are recommended for application during Green Line construction and during operation. These mitigation measures are presented by project segment and the different proposed alternative alignments.

SMP will coordinate with the OAHP, the City of Seattle consulting parties, and the public to identify mitigation measures that will be addressed in a formal MOA. The MOA will be completed and included in the Record of Decision (ROD). The following discussion presents some of the mitigation measures that could be incorporated into the MOA (see Table 4.11-2 for a summary of effects). The potential types of mitigation for historic resources associated with project effects are described below. Specific mitigation issues associated with each segment are listed. Discussions with SMP and agencies regarding historic resource mitigation are ongoing and will be finalized prior to the publication of the Coast Guard Record of Decision. The final MOA discussion will focus on the Preferred Alternative.

4.11.4.3 Operation

Archaeological Resources

No mitigation measures for long-term effects to archaeological or traditional cultural resources are required for operation of the Green Line.

Historic Resources

Demolition

Some of the alternatives could result in the demolition of historic resources. A description of the locations and types of resources potentially affected by demolition is listed in Table 4.11-3. There are several options to mitigate demolition. Avoiding the resource through selection of other alternatives and changes in design of a project feature in the specific area of the affected resource(s) could eliminate the need for demolition. Elements of the resource could be reflected or preserved in the design of the station or other structure whose construction would cause the demolition. If these options are not feasible, recordation (a detailed inventory for historic records) and salvage of the resource could mitigate for its loss. In cases where a resource is found to be adversely affected, recordation of the resource would be completed in the form of Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) level documentation, which follows National Park Service regulations.

Demolition of any historic resource within the Pioneer Square Preservation District would be reviewed pursuant to SMC 23.66, and the demolition of any designated City landmark would be reviewed pursuant to SMC 25.12. Appropriate mitigation would be pursued as required in those provisions.

Non-site-specific mitigation could involve finding other opportunities in the community for mitigation measures that are not specific to the affected site. Some of the options for non-site-specific mitigation include the development of educational interpretive displays; creating design guidelines that focus on compatible materials, massing, and scale with historic resources for the introduction of new construction (such as station design); historic Multiple Property NRHP Nominations for certain neighborhoods; and professional publications. These mitigation measures would not be direct mitigation for the effect of the Green Line but would relate to other resources in the area.

Traffic Congestion/Access/Isolation

Loss of access or isolation of resources could be minimized through design treatments. Creation of alternative access points, more visible temporary signage, or additional traffic control could facilitate accessibility. There may be a need for a formal Access Mitigation Plan during construction as part of the undertaking (refer to Section 4.1, Transportation).

Noise and Vibration

Increased vibration after the construction of the Green Line could be minimized through vibration suppression, including the setting back of support columns from buildings and effective maintenance to control ground-borne vibration, and design treatments. There should be no adverse effects to historic resources from the long-term function of the Green Line (see Section 4.7, Noise and Vibration). Mitigation measures for vibration related to construction of the Green Line can be found in Section 4.17, Construction, and in Chapter 5, Mitigation Program.

Visual

There would be effects associated with changes in visual character due to operation of the Green Line. Some visual effects could be mitigated through the placement of guideway columns to avoid major entrances to historic buildings. Station design, construction, materials, and street improvements could be chosen to compliment existing building and street settings. Use of low-effect colors and low-glare glass could reduce some of the effects on stations within the Pioneer Square Historic District or areas with a high number of historic resources, such as the Downtown Segment.

In areas where the concentration of historic resources is very high, such as the Downtown Segment and the Pioneer Square Historic District, locations of columns could be planned to avoid placement in front of historic resources, especially building entries. Due to the number of visual effects to historic resources identified within the undertaking where there are no direct mitigation measures, off-site mitigation measures could be proposed, such as the development of a Multiple Property National Register Nomination for specific types of historic resources (see Appendix NN, Section 106 Cultural Resources Report, and Section 4.5, Visual Quality and Aesthetic Resources).

The design for Green Line stations and associated street improvements adjacent to historic resources would be subject to design review to ensure compatibility with historic resources.

Change of Use

No significant adverse effects to historic uses in historic districts have been identified at this time.

Segment 1: Ballard Segment

The types of mitigation measures for all of the alternatives within this segment are the same because the types of effects are the same (visual, isolation/alteration of surrounding environment). Under the proposed Alternative 1.2, there could be demolition or alteration of this historic resource due to the potential location of the guideway directly above the building.

The potential mitigation measures listed above could be undertaken for historic resources within this segment. Creative design solutions could be applied to the design, construction, and materials of a new Green Line bridge as currently proposed that parallels the existing Ballard Bridge (B-140).

Segment 2: Interbay/Magnolia Segment

The types of mitigation measures for all the alternatives within this segment are the same for historic resources because the types of effects are the same (visual, isolation/alteration of surrounding environment). The potential mitigation measures listed above could be undertaken for historic resources within this segment. The NRHP-eligible Tsubota Steel and Pipe building (I-52) would be demolished under the Howe 1A station option and the Naval Depot Building (I-99) would be demolished with the construction of an operations center in Interbay. Mitigation for the demolition of these buildings would consist of HABS documentation.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The type of mitigation measures for all the alternatives within this segment are the same for historic resources because the types of effects are the same (visual, demolition, or alteration of property). In cases where a resource is found to be adversely affected due to demolition or alternation of property recordation of the resources (HABS/HAER level) would be completed before any mitigation action.

The existing monorail is largely responsible for the community's interest in the construction of a new monorail system in Seattle. Preservation of the existing monorail through incorporating the structure into the new Green Line system would be infeasible due to differing technology and engineering systems necessary for the construction of the new system. Leaving the existing monorail in place and routing the new system around it would lead to isolation of the old system due to its limited use area compared to the new system. Furthermore, constructing parallel monorail lines on Fifth Avenue would create an adverse visual effect. In addition to HABS/HAER level documentation, the removal of the existing monorail could be mitigated with the introduction of interpretive exhibits featuring the original cars from the monorail at a location such as the Museum of History of Industry (MOHAI). SMP could also provide tours of the new Green Line that would discuss the monorail's legacy in Seattle by highlighting the World's Fair and development of the original monorail system.

Non-site-specific mitigation could be undertaken for the numerous historic resources within the Queen Anne/Seattle Center/Belltown Segment that could be visually affected by the introduction of new, non-compatible construction of the Green Line guideway and stations. A Multiple Property NRHP Nomination of Apartment Buildings within the Lower Queen Anne and Downtown neighborhoods could be required in the MOA.

Segment 4: Downtown/Pioneer Square Segment

The height of the guideways could block views of the decorative belt coursing located above the second story of some early twentieth century historic buildings within the Downtown segment. Visual simulations were prepared for many buildings in the Downtown Segment and are included in the Section 106 Cultural Resources Report (Appendix NN). The MOA will include specific guidance for the Yesler Station design to mitigate visual impacts. SMP will work with a design team to develop a station that is approved by the SHPO and Pioneer Square Preservation Board.

Recordation of the resources (HABS/HAER level) would be completed in cases of adverse effects due to demolition or alteration of surrounding environment. Resources that may be demolished include the Sheridan Apartments (D-26), Centennial Building (D-37), Eitel building (D-57), and the Federal Reserve Bank Building (D-67). Creative design solutions that avoid demolition and/or minimize effects to historic structures could also become mitigation for adverse visual effects.

Non-site-specific mitigation would be undertaken for the numerous historic resources within the Downtown Segment that would be visually affected by the introduction of new, non-compatible construction of the Green Line guideway and stations. A Multiple Property National Register Nomination of Apartment Buildings within the Downtown neighborhoods could be included in the MOA.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The type of mitigation measures for all the alternatives within this segment are the same for historic resources because the types of effects are the same (visual, isolation/alteration of surrounding environment). The potential mitigation measures listed above could be undertaken for historic resources within this segment.

Segment 6: West Seattle Segment

The type of mitigation measures for all the alternatives within this segment are the same for historic resources because the types of effects are the same (visual, demolition/alteration of property). Recordation of the resources (HABS/HAER level) would be completed before any mitigation action in cases where a resource is adversely affected due to demolition or alteration of the property.

Non-site-specific mitigation could be undertaken for the numerous historic resources within the West Seattle Segment that could be visually affected by the introduction of new, non-compatible construction of the Green Line guideway and stations. A Multiple Property NRHP Nomination of Craftsman Style Buildings within the West Seattle neighborhood could be required in the MOA.

4.11.5 Significant Unavoidable Adverse Impacts

4.11.5.1 Archaeological Resources

No significant unavoidable adverse effects to archaeological resources or traditional cultural resources would occur. All effects could be mitigated through development of the MOA, an Archaeological Treatment Plan, and an Archaeological Construction Monitoring Plan for the Green Line project.

4.11.5.2 Historical Resources

New construction of the proposed Green Line could have a significant unavoidable adverse effect by altering the character of the setting of significant historic resources and the visual character of the Pioneer Square Historic District (D-132). Visual effects to the district and individual historic resources within the district would adversely affect their visual integrity. Some of these effects could be mitigated through creative design solutions, such as compatible station design and the placement of columns away from historic buildings. Other adverse effects could be mitigated through off-site mitigation measures (described in the mitigation section) that could compensate for effects. The demolition of historic buildings, however, would be a significant unavoidable adverse effect, unless it can be avoided through redesign.

4.12 ENVIRONMENTAL HEALTH

The Green Line is proposed to be constructed in an urban area in which many properties have been used in ways (such as gas stations, manufacturing plants, etc.) that could have caused hazardous materials to be released into the soil. This section evaluates the potential for encountering hazardous materials during construction of the Green Line. For the purpose of identifying environmental conditions that may affect or be affected by the Green Line, the areas evaluated were defined as follows:

- Right-of-way areas along the Green Line alternative alignments.
- Property parcels beneath and immediately adjacent to the Green Line alternative alignments.
- Property acquisition parcels and adjacent parcels within a probable distance of effect (assumed to be 500 feet) to the acquisition parcels for the Green Line alternative alignments. For the purpose of this study, the acquisition parcels evaluated included full-acquisition parcels and partial-acquisition parcels. Air rights and touchdown parcels were not evaluated due to the uncertainty of the touchdown point locations.

For additional information on Green Line construction impacts, see Section 4.17, Construction.

This section also contains a brief discussion of electronic and magnetic fields (EMF) and their potential effect upon the Green Line, presented in Section 4.12.6.

4.12.1 Methodology

The data sources used to identify hazardous materials sites along the Green Line alternative alignments included federal and state regulatory databases, historical records, and site visits to each of the alignment alternatives. To support ongoing property acquisition research, CDM is conducting Phase I and II Environmental Site Assessments (ESAs) along the Green Line. Specific information from these ESAs have been incorporated into this Final EIS for the C-1 Operations Center site in the Interbay segment.

4.12.1.1 Federal and State Database Sites

Federal and state environmental databases were reviewed for sites with documented releases or potential releases of hazardous materials to the environment. The sites were compiled and mapped by Environmental Data Resources, Inc. (EDR) within a one-mile search distance from the Green Line alignment alternatives. To focus the study on sites with a higher probability of affecting the Green Line, only the following sites were evaluated:

- Documented release sites on or immediately adjacent to the Green Line alignment alternatives.
- Documented release sites on or within 500 feet of property acquisition parcels.
- Potential release sites on or immediately adjacent to property acquisition parcels.

Unless they are otherwise defined, these sites are referred to as “database sites” in the remainder of this section’s text.

4.12.1.2 Sanborn Maps

Sanborn Fire Insurance Maps depict the commercial, industrial, and residential sections of cities. Maps were reviewed from 1929 to 1969 for most of the alignment alternatives to identify historical activities that may have affected soil and groundwater. Maps were reviewed for parcels immediately adjacent to

the alignment alternatives, for property acquisition parcels, and for most parcels immediately adjacent to property acquisition parcels. Sites thus identified have been defined as “historical” sites.

4.12.1.3 Site Reconnaissance

A site reconnaissance of the Green Line alignment alternatives was completed by driving and walking portions of each alternative. The reconnaissance focused on the following items:

- Verifying the location of documented release sites on or immediately adjacent to the Green Line alignment alternatives. In addition, verifying the location of documented release sites on property acquisition parcels and within 500 feet of most property acquisition parcels.
- Verifying the location of potential release sites on or immediately adjacent to most property acquisition parcels.
- Evaluating site use on or immediately adjacent to the Green Line alternative alignments and most property acquisition parcels.

4.12.2 Regulatory Setting

Federal and state regulations govern dangerous, hazardous, and toxic substances. The U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) maintain databases that track sites with potential and confirmed releases to the environment and facilities that generate hazardous materials. The EPA administers the following federal laws and regulations:

- Resource Conservation and Recovery Act (RCRA)(Title 42, Chapter 82)
- Comprehensive Environmental Response Compensation and Liability Act (CERCLA)(Title 42, Chapter 103)
- Toxic Substances Control Act (TSCA)(Title 15, Chapter 53)

Ecology administers the following state laws and regulations:

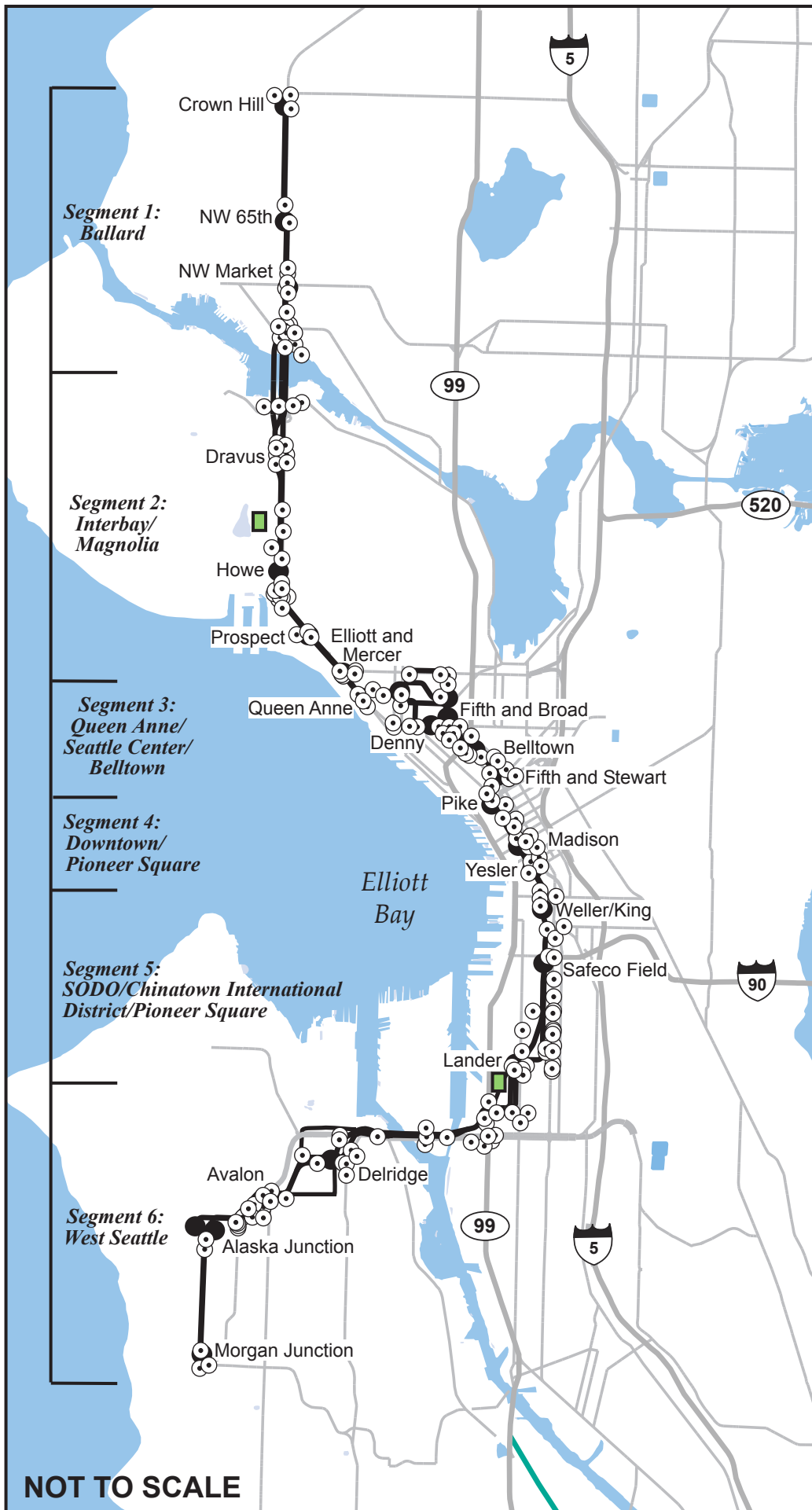
- Model Toxics Control Act (MTCA)(WAC 173-340)
- Dangerous Waste Regulations (WAC 173-303)
- Underground Storage Tank (UST) Regulations (WAC 173-360)
- Solid Waste Handling Standards (WAC 173-350)

4.12.3 Affected Environment

The environmental concerns that have been identified for the Green Line alignment alternatives fall into two categories.

The first category includes documented release sites based upon EDR regulatory database records. The locations of these release sites are shown in Figure 4.12-1 and the number of release sites per segment is presented in Table 4.12-1. More detailed figures and tables with more information about the release sites are presented in Appendix S, Environmental Health Backup Information.

**Figure 4.12-1
Documented EDR
Release Sites along
the Green Line Corridor**



○ Documented Release Sites Identified By Environmental Data Resources, Inc. (2003). This figure only shows locations of documented release sites within the vicinity of the Green Line.



The second category includes potential release sites based upon EDR regulatory database records, Sanborn Maps, and site reconnaissance observations. The number of potential release sites per segment is presented in Table 4.12-1. More detailed information (figures and tables) on the potential release sites is presented in Appendix S.

Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
BALLARD SEGMENT				
Property Acquisition Alternatives:				
Area No. 1				
Crown Hill 1 and 1A (West, 85 th)	0	0	1	1
Adjacent/Crown Hill 1 and 1A	1	0	1	0
Crown Hill 2 (Center)	2	0	1	0
Adjacent/Crown Hill 2	0	0	3	0
Area No. 2				
NW 65 th Street 1, 1A, and 1B (West)	0	1	1	0
Adjacent/NW 65 th 1, 1A, and 1B	1	1	3	2
NW 65 th 2 (Center)	0	0	0	0
Adjacent/NW 65 th 2	3	3	1	1
Area No. 3				
NW Market 1, 2, 3, 3A	0	0	5	0
Adjacent NW Market 1, 2, 3, 3A	4 ^a	6 ^a	21 ^a	2
Alignment Alternatives				
Alternative 1.1/1.1(s)/1.2 (85 th Street NW to 50 th Street NW)	3	10	32	20
Alternative 1.1.1 or 1.1.1(s) (50 th Street NW to Ship Canal)	4 ^b	15	12	14
Alternative 1.1.2 (50 th Street NW to Ship Canal)	2 ^b	6	30	4
Alternative 1.2 (50 th Street NW to Ship Canal)	4 ^b	9	21	14
Total for Ballard Segment:	24	51	132	58
INTERBAY/MAGNOLIA SEGMENT				
Property Acquisition Alternatives:				
Area No. 4				
Fishermen's Terminal	2	5	0 ^c	0 ^c
Adjacent to Area No. 4 (Fishermen's Terminal)	6 ^a	5	0 ^c	0 ^c
Area No. 5				
Dravus 1 (16 th)	0	1	1	0
Adjacent to Dravus 1	9 ^a	6	6	2
Dravus 1A	0	0	1	0
Adjacent to Dravus 1A	9 ^a	6	8 ^a	1

**Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line
(continued)**

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Dravus 1B	0	0	0	0
Adjacent to Dravus 1B	5	1	11 ^a	1
Dravus 2 (15 th)	0	0	1	0
Adjacent to Dravus 2	9 ^a	0	1	1
Area No. 6				
Operations Center C-1	0	0	5	0
Adjacent to Operations Center C-1	3 ^a	2	2	4
Area No. 7				
Howe 1 and 2	0	0	4	0
Adjacent to Howe 1 and 2	4	0	15	1
Area No. 8				
Howe 1A (Blaine)	0	0	1	0
Adjacent to Howe 1A (Blaine)	9 ^a	4 ^a	4	0
Area No. 9				
Prospect 3 (West)	0	0	3	1
Adjacent to Prospect 3	4	4	7	0
Area No. 10				
Elliott and Mercer 1, 1A, and 2	0	0	1	0
Adjacent to Elliott and Mercer 1, 1A, and 2	9 ^a	8 ^a	17	0
<u>Alignment Alternatives:</u>				
Ship Canal/Fishermen's Terminal to W Ruffner Street				
Alternative 2.1.1	0	0	1	0
Alternative 2.1.2	0	0	0	0
Alternative 2.2	0	1	2	0
W Ruffner Street to W Bertona Street/Property Acquisition Area No. 5				
Alternative 2.1, 2.1(s)	0	2	6	8
Alternative 2.2	0	0	6	2
W Barrett Street/ Property Acquisition Area No. 5 to W Howe Street				
Alternative 2.1, 2.1(s), and 2.2	2	3	18	7
W Howe Street to W Prospect Street				
Alternative 2.1, 2.1(s), and 2.2	7	8	61	9
W Prospect Street to End of Segment				
Alternative 2.1, 2.1(s), and 2.2	0	10	21	0
Total for Interbay Segment:	78	66	203	37
QUEEN ANNE/SEATTLE CENTER/BELLTOWN AND DOWNTOWN/PIONEER SQUARE SEGMENTS				
<u>Property Acquisition Alternatives:</u>				
Area No. 11				
Seattle Center/Queen Anne 1, 1A, and 2	0	0	0	0
Adjacent to Seattle Center/Queen Anne 1, 1A, and 2	5 ^a	0	1	0

**Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line
(continued)**

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Area No. 12				
Seattle Center/Fifth and Broad 1 (Southeast)	0	0	3	0
Adjacent to Seattle Center/Fifth and Broad 1	3 ^a	2 ^a	12	0
Seattle Center/Fifth and Broad 1A	0	0	1	0
Adjacent to Seattle Center/Fifth and Broad 1A	0	0	3 ^a	0
Seattle Center/Fifth and Broad 2 (Harrison)	0	0	5	0
Adjacent to Seattle Center/Fifth and Broad 2	2	3 ^a	1	0
Area No. 13				
Denny 3	0	0	1	0
Adjacent to Denny 3	2	2	3	1
Area No. 14				
Belltown 1, 1A, 2, 3	0	0	2	0
Adjacent to Belltown 1, 1A, 2, 3	6	2	7	0
Area No. 15				
Fifth and Stewart 1, 1A, 2, 2A (Northwest)	0	0	1	0
Adjacent to Fifth and Stewart 1, 1A, 2, 2A	6 ^d	1	1	0
Fifth and Stewart 2 (Virginia)	0	0	1	0
Adjacent to Fifth and Stewart 2	6 ^d	3	2	0
Fifth and Stewart 3 (Lenora)	0	0	0	0
Adjacent to Fifth and Stewart 3	6 ^d	0	4	0
Area No. 16				
Pike 1 (A and B), 2, 2A, 3	0	0	0	0
Adjacent to Pike 1 (A and B), 2, 2A, 3	6	0	1	0
Area No. 17				
Madison 1, 2, 2A, 3	0	0	0	0
Adjacent to Madison 1, 2, 2A, 3	5	4 ^a	2	0
Area No. 18				
Yesler 1 and 2	1	0	1	0
Adjacent to Yesler 1 and 2	3	4 ^a	0	0
<u>Alignment Alternatives:</u>				
W Harrison Street to First Avenue N				
Alternative 3.1 and 3.2	1	8	6	0
First Avenue N to Thomas Street				
Alternative 3.1	0	0	0	0
Alternative 3.2	4	4	10	0
Alternative 3.3	0	1	2	0

**Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line
(continued)**

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
First Avenue N to Cedar Street				
Alternative 3.5	1	4	21	5
Denny Way to South Jackson Street				
Alternatives 3.1, 3.2, 3.5, 4.1, 4.1.1, 4.2, 4.3, and 4.4	4	24	24	4
Total for Queen Anne/ Seattle Center/Belltown and Downtown Segments:	61	62	115	10
SODO/CHINATOWN INTERNATIONAL DISTRICT/PIONEER SQUARE SEGMENT				
<u>Property Acquisition Alternatives:</u>				
Area No. 19				
Weller/King Street Station	1	0	1	0
Adjacent to Weller/King Street Station	2	1	0	0
Area No. 20				
S Weller Street to S Royal Brougham Way	0	0	0	0
Adjacent to S Weller Street and S Royal Brougham Way	7 ^a	3 ^a	1 ^a	0
Area No. 21				
Safeco Field Station	0	0	2	0
Adjacent to Safeco Field Station	4	1	10	4
Area No. 22				
S Atlantic Street to S Holgate Street	0	0	0	0
Adjacent to S Atlantic Street and S Holgate Street	6 ^a	5 ^a	23 ^a	8 ^a
Area No. 23				
Third Avenue S and S Lander Street	0	0	0	0
Adjacent to Third Avenue S and S Lander Street	10 ^a	10 ^a	19 ^a	9 ^a
Area No. 24				
Lander 1 (Northeast)	0	0	4	0
Adjacent to Lander 1	2 ^e	1	8	0
Lander 2 (Southwest)	0	0	4	2
Adjacent to Lander 2	3	1	18	2
Lander 3 (Diagonal)	0	0	8	0
Adjacent to Lander 3	2 ^e	0	4	0
Lander 4 ^f (Utah)	0	1	2	1
Adjacent to Lander 4	0	0	7	0
C-2 Operations Center ^f	2	1	2	1
Adjacent to C-2 Operations Center	0	0	7	0
Area No. 25				
S Horton Street	0	0	0	0
Adjacent to S Horton Street	8 ^a	10 ^a	19 ^a	9 ^a

**Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line
(continued)**

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
<u>Alignment Alternatives:</u>				
South Jackson Street to S King Street				
Alternatives 5.1 and 5.2	0	0	0	0
S Holgate Street to S Stacy Street				
Alternatives 5.1, 5.2, and 5.2(s)	4	0	8	7
S Lander Street to S Hanford Street				
Alternatives 5.1.1 and 5.1.2	0	7	12	8
Total for SODO Segment:	53	41	173	51
WEST SEATTLE SEGMENT				
<u>Property Acquisition Alternatives:</u>				
Area No. 26				
Terminal 25	0	0	0	0
Adjacent to Terminal 25	11 ^a	8 ^a	6 ^a	4 ^a
Area No. 27				
Delridge 3 (Nucor)	0	1	1	1
Adjacent to Delridge 3	3 ^a	0	1	0
Area No. 28				
Delridge 1, 1A, 2 and 4	0	0	0	0
Adjacent to Delridge 1, 1A, 2 and 4	6 ^a	0	1	1
Area No. 29				
Avalon 1 (Center)	0	0	0	0
Adjacent to Avalon 1	2 ^a	1	4	0
Avalon 2A, and 2B (35 th)	0	0	1	0
Adjacent to Avalon 2A, and 2B	2	1	1 ^a	4
Area No. 30				
Alaska Junction 1 and 1A (42 nd /Edmunds)	0	0	2	0
Adjacent to Alaska Junction 1 and 1A	1 ^g	2	4	2
Alaska Junction 2 (44 th /California)	0	0	0	0
Adjacent to Alaska Junction 2	1 ^g	1	0	2
Area No. 31				
Morgan Junction 1 and 1A (West)	0	0	2	1
Adjacent to Morgan Junction 1 and 1A	1	0	2	
Morgan Junction 2 (Center)	0	0	0	1
Adjacent to Morgan Junction 2	2 ^a	2 ^a	1	1
<u>Alignment Alternatives:</u>				
S. Horton Street and Colorado Avenue S. to west side of West Seattle Bridge				
Alternatives 6.1, 6.1(s), 6.1.1, 6.1.1(s), 6.2, 6.1.2, 6.1.2(s)	12	10	26	3
West side of West Seattle Bridge to Avalon Station Area				
Alternatives 6.1, 6.2, 6.4, 6.4(s)	3	2	0	0

**Table 4.12-1. Total Documented and Potential Release Sites in Affected Area, Green Line
(continued)**

Alignment and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
West side of West Seattle Bridge to SW Yancy Street and SW Avalon Way				
Alternative 6.3(s)	4	2	27 ^{a, b}	0
Delridge Way SW and SW Andover Street to SW Genesee Street and Avalon Way SW				
Alternative 6.5	0	1	NC	0
Avalon Station Area to 39th Avenue SW and SW Alaska Street				
Alternatives 6.1.3, 6.1.4	5	6	17	0
Avalon Station Area to 39th Avenue SW and SW Alaska Street				
Alternatives 6.2, 6.2.1, 6.2.2	0	3	5	3
39th Avenue SW and Alaska Junction Station Area				
Alternatives 6.1, 6.2	4	4	8	2
Alaska Junction Station Area to Morgan Junction Station Area				
Alternatives 6.1, 6.1.6, 6.1.6(s), 6.2	1	2	24	1
Total for West Seattle Segment:	58	46	133	26

^a Some of these sites may be located on acquisition parcels.

^b Some of these sites may effect more than one alternative.

^c Sanborn map review and site reconnaissance not conducted on all of Fishermen's Terminal.

^d There are a total of six documented release sites adjacent to Fifth and Stewart 1, 2, and 3.

^e These two release sites are adjacent to both Lander 1 and 3.

^f The Lander 4 station and C-2 Operations Center are approximately at the same location.

^g There is one documented release site near Alaska Junction 1 and 2.

NC No Sanborn Map coverage

Known and suspected hazardous materials within the study area are listed below:

- Asbestos
- Lead-based paint
- Total petroleum hydrocarbons (TPH)
- Polychlorinated biphenyls (PCBs)
- Metals
- Cyanide
- Solvents
- Polyaromatic hydrocarbons (PAHs)
- Pesticides
- Herbicides
- Refuse
- Methane gas
- Base/neutral/acids
- Phenolic compounds

4.12.4 Impacts

Releases of hazardous materials can create adverse impacts on public health and the environment. The purpose of this section is to identify hazardous materials impacts that could be associated with the operation of the Green Line. Construction-related impacts are discussed in Section 4.17, Construction, and below in Section 4.12.4.2.

4.12.4.1 Operational Impacts

Potential operational impacts of the Green Line on environmental health with respect to hazardous materials would involve use of chemicals (e.g. lubricants, solvents, fuels) during regular maintenance of monorail machinery and use of maintenance vehicles to service the system. Hazardous materials would be used, and hazardous waste would be generated primarily at the designated Operations Center. However, operational impacts are not anticipated at the Operations Center due to the development and implementation of standard operating procedures (SOPs) and an emergency response plan to handle situations such as chemical spills.

The overall approach is to minimize the presence of hazardous materials at the Operations Center. The materials that are present will be strictly controlled both through design of the physical facility and through SOPs. Known materials include:

- Lubricants
- Solvents
- Fuels
- Detergents
- Refrigerants
- Dust
- Fumes

Similar long-term effects would apply to either Operations Center alternative.

4.12.4.2 Construction Impacts

The construction impact analysis focused on the location and nature of documented release sites (EDR release sites) along the alignment alternatives (including right-of-way areas) and in the vicinity of property acquisition parcels and how they may affect the construction of the Green Line. This impact analysis also evaluated potential release sites as well as the regulatory requirements that may apply to various types of construction on or immediately adjacent to property acquisition parcels and along the alignment alternatives (including right-of-way areas). Releases to groundwater probably have the greatest potential to affect construction activities because of the high potential for the contamination to migrate.

Segment 1: Ballard Segment

There are three groups of property acquisition parcels along this segment and they are all associated with station alternatives.

- Property Acquisition Area No. 1 (Crown Hill 1, 1A, and 2 station alternatives) – There are three documented release sites on or adjacent to this acquisition parcel. One is a petroleum release to soil that is approximately 300 feet from the acquisition area. The other two are on or adjacent to the Crown Hill 2 portion of the acquisition, but have been investigated and both received a No

Further Action (NFA) determination from Ecology. One of these sites had a release of TPH to soil and the nature of the release from the second site is unknown. Residual contamination may still be encountered during station construction activities at Crown Hill 2 because TPH impacted soil may have been left in place.

Three potential release sites were also identified on this acquisition area. A gas station was previously located on Crown Hill 1 and a heating equipment business was located on Crown Hill 2. In addition, a millwork business is currently located on Crown Hill 1 and 1A. Adjacent sites of concern include three former gas stations and a former rental facility. TPH contamination may be encountered during construction activities at Crown Hill 1 and 1A, due to the former gas station.

- Property Acquisition Area No. 2 (NW 65th 1, 1A, 1B, and 2 station alternatives) – There are four documented release sites adjacent to this acquisition. Three of these sites are near the NW 65th 2 station and each involved a release of TPH to soil. The fourth site is adjacent to the NW 65th 1, 1A, and 1B station alternatives and involved a release of TPH to both soil and groundwater, but received an NFA from Ecology. Residual TPH contamination in groundwater may be present near NW 65th 1, 1A, and 1B and could affect station construction activities.

Two potential release sites were also identified on this acquisition area. The business that currently occupies NW 65th 1, 1A, and 1B is Walt's Radiator, currently listed as a federal database site. In the past, this site also operated as a gas station. Adjacent sites of concern to NW 65th 1, 1A, and 1B include former businesses (gas stations, car repair, car wash), current businesses (dry cleaner, radiator/garage facility) and a state and federal database site. TPH contamination may be encountered during construction activities at NW 65th 1, 1A, and 1B due to the former gas station and the presence of Walt's Radiator on the site.

Adjacent sites of concern to NW 65th 2 include a former gas station, a current garage with hydraulic lifts, and state and federal database sites.

- Property Acquisition Area No. 3 (NW Market 1, 2, 3, and 3A station alternatives) – There are four documented release sites on or adjacent to this acquisition. Two of these sites had a release of TPH to soil and a third site had a release of TPH to both soil and groundwater. The fourth site had a release of solvents and TPH to both soil and groundwater. Station construction activities may encounter contaminated soil and groundwater in this area.

Gas stations were once present on all three sites (NW Market 1, 2, 3, and 3A). A paint store was also located on NW Market 3A. Adjacent sites of concern include former businesses (gas station, used autos, painting, dry cleaning, printing, auto repair), current businesses (gas station, printing company), and current state and federal database sites.

Additional documented and potential release sites along the alternative alignments in the Ballard Segment, but not included above in the acquisition discussions, are discussed below.

- *Alternative 1.1/1.1(s)/1.2 (85th Street NW to 50th Street NW)*

There are three release sites along the alignment in this portion of Alternatives 1.1 (West Side of 15th), 1.1(s) (West Side of 15th single beam) and 1.2 (Center of 15th). Two of these are petroleum releases to soil located north of the NW Market station acquisition, and the third is a petroleum release to soil and groundwater located near the NW 51st Street block of 15th Avenue NW. Construction of drilled shafts for guideway columns may encounter contaminated soil and groundwater in these areas.

The number of potential release sites along the alignment in this portion of Alternatives 1.1, 1.1(s), and 1.2 included 10 database sites, 32 historical sites, and 20 reconnaissance sites.

- *Alternative 1.1.1/1.1.1(s)/1.1.2/1.2 (50th Street NW to Ship Canal)*

Ten documented release sites were identified on or adjacent to these alternative alignments. Two of these release sites have affected both soil and groundwater, one reporting a release of petroleum products, solvents, metals, cyanide, and PCBs, the other reporting a release of petroleum products and possibly metals and cyanide. These sites are on or directly adjacent to one or more of the alternative alignments near 49th Avenue NW and 48th Avenue NW. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in these areas. Of the remaining eight sites, two had reported releases of TPH to soil, and detailed release information was not available for the other six sites.

The number of potential release sites along the alignment in this portion of Alternatives 1.1.1, 1.1.1(s), 1.1.2, and 1.2 included 30 database sites, 63 historical sites, and 32 reconnaissance sites.

- *Alternative 1.1/1.1.1/1.1.1(s)/1.1.2/1.2 (Ballard Segment, Lake Washington Ship Canal)*

Sediments in the Lake Washington Ship Canal near all of the Ballard Crossing alternatives appear to be contaminated with various chemicals. See Section 4.14.4.1, Water, for more details on the types of contaminants and potential concentrations.

The selected stations for the Preferred Alternative include Crown Hill 1A, NW 65th 1B, and NW Market 3A. The selected Alignment Alternative is 1.1(s) with West Bridge (Alternative 1.1.1). A summary of impacts for the Preferred Alternative is listed below.

Table 4.12-2. Total Documented and Potential Release Sites for the Preferred Alternative, Ballard Segment, Green Line

Preferred Alternative Stations and Alignment	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Stations:				
Crown Hill 1A	0	0	1	1
Adjacent to Crown Hill 1A	1	0	1	1
NW 65 th 1B	0	1	1	1
Adjacent to NW 65th 1B	1	1	3	2
NW Market 3A	0	0	2	0
Adjacent to NW Market 3A	4 ^a	6 ^a	21 ^a	2
Alignment:				
Alternative 1.1(s)	3	10	32	20
Alternative 1.1.1	4 ^b	15	12	14
Total	13	33	73	41

^a = Some of these sites may be located on acquisition parcels.

^b = Some of these sites may affect more than one alternative.

Segment 2: Interbay/Magnolia Segment

There are seven groups of property acquisition parcels in this segment. These acquisition areas are associated with station and operation center alternatives, and are also associated with land needed in the Fishermen's Terminal area near the Ship Canal.

- Property Acquisition Area No. 4 (Fishermen's Terminal) – There are eight documented release sites on or near this acquisition. Two of the sites are on Fishermen's Terminal and have releases to both soil and groundwater (TPH, metals, cyanide, solvents, PAHs). Three of the sites are on or are immediately adjacent to Fishermen's Terminal or are immediately adjacent and have reported releases to soil and groundwater. Contaminants of concern include TPH, metals, cyanide, and solvents. One of these three sites has also impacted surface water, sediments, and air. Construction of drilled shafts for guideway columns or bridge supports may encounter contaminated media in this area. The remaining three sites are approximately 300 to 400 feet away from Fishermen's Terminal and have reported releases of TPH to soil. However, because TPH does not migrate significantly in soil, these last three sites have a lower potential of affecting the acquisition.

Potential release sites on or immediately adjacent to Fishermen's Terminal included railroad tracks and 10 state and federal database sites.

- Property Acquisition Area No. 5 (Dravus 1, 1A, 1B, and 2 station alternatives) – There are nine documented release sites on or near this acquisition. Three of the sites are on or immediately adjacent to Dravus 1 and 2 and have reported releases of petroleum compounds to soil and/or groundwater. Station construction activities may encounter contaminated soil and groundwater in this area. Five of the sites are located approximately 200 to over 500 feet away from the acquisition (Dravus 1, 1A, 1B, 2) along Alternatives 2.1, 2.1(s), and 2.2 and have reported releases of various compounds to soil and/or groundwater. These five sites have a lower potential to affect acquisition of the station parcels, but may affect construction activities along the guideway. Another site of concern for this area is the Interbay Landfill, located approximately 250 to 500 feet to the south. The Dravus 1B station alternative is located the closest to the landfill. It is possible that the landfill may extend beneath the entire Dravus acquisition based upon hazard maps generated by the City of Seattle (see Figure 4.1-5). The landfill has a reported release of various compounds (solvents, metals, cyanide, pesticides, PAHs) to soil, groundwater, and surface water. The landfill also is generating methane gas that may be migrating away from the landfill. Station construction activities in this general area should be prepared to encounter possible contaminated soil and groundwater, debris material (possible refuse), and methane gas.

Three potential release sites were identified on this acquisition. Dravus 1 was an auto parts store, Dravus 1A was an auto repair/service station and Dravus 2 used to be a gas station. Adjacent sites of potential release include former businesses (auto repair, gas station, contractor storage yard, testing lab), current businesses (printer and Union 76 Station), and current state and federal database sites.

- Property Acquisition Area No. 6 (C-1 Operations Center) – There are three documented release sites on or adjacent to this acquisition. The sites include a diesel spill site, a site with a reported release of TPH to soil and groundwater, and the Interbay Landfill. The landfill, located directly to the north of the C-1 Operations Center alternative, has a reported release of various compounds (solvents, metals, cyanide, pesticides, PAHs) to soil, groundwater, and surface water. However, the recent Expedited Phase II ESA by CDM in and around the proposed C-1 Operations Center site did not encounter these compounds significantly above cleanup action levels, nor did they encounter landfill refuse or methane gas (Peterson 2003). Construction activities in this general area, however, should be prepared to encounter possible contaminated soil and groundwater.

Five potential release sites were identified on this acquisition. The C-1 Operations Center was used in the past as an insecticide manufacturer, oil storage company, nursery, mattress manufacturer, and sheet metal works. Construction activities in this area should be prepared to encounter potentially contaminated soil and groundwater due to these past activities on the C-1

Operations Center site. Adjacent sites of concern include former businesses (rubber cement manufacturer, welding/machine shop), current businesses or operations (National Guard, railroad tracks, laundry facility, warehouse), and current state and federal database sites.

- Property Acquisition Area No. 7 (Howe 1 and 2 station alternatives) – There are four documented release sites near this acquisition. Two of the sites are located along the guideway approximately 200 to 400 feet south of the acquisition. Both sites reported a release of TPH to soil and groundwater. One of these sites is conducting groundwater monitoring. A third site with a reported diesel spill is located north of the site near the intersection of 15th Avenue W and W Armory Way. These three sites have a lower potential to affect acquisition of the station parcels, but may affect construction activities along the alignment. The fourth site of concern for the Howe acquisition is the Interbay Landfill, which is located approximately 500 to 800 feet to the north. The landfill has a reported release of various compounds (solvents, metals, cyanide, pesticides, PAHs) to soil, groundwater, and surface water. The landfill also is generating methane gas that may be migrating away from the landfill. Station construction activities at this acquisition should be prepared to encounter contaminated groundwater and methane gas.

Four potential release sites were identified on this acquisition. Howe 1 and 2 were previously used as a metal forgery, factory, bottling works, and meat cutting facility. Adjacent sites of potential concern include former businesses (shingle factory, dry kiln, gas station, warehouse, pipe storage, woodworking shop) and current businesses (Union 76 Station). Station construction activities may encounter contamination due to the former businesses on the site.

- Property Acquisition Area No. 8 (Howe 1A, Blaine) – There are nine release sites on or in the vicinity of this acquisition. Four of the release sites are on or immediately adjacent to the acquisition and have reported releases of petroleum compounds and solvents to soil and groundwater. These sites have also reported a suspected release of cyanide and metals to soil and groundwater. The remaining five sites are approximately 100 to 400 feet away from the acquisition and have reported releases to TPH and cyanide to soil and groundwater. Some of these sites have also reported a suspected release of solvents, PAHs, and metals to soil and groundwater. Groundwater extraction is occurring at one of these release sites located approximately 300 feet from the acquisition. Station construction activities may encounter subsurface contamination due to the abundance of reported releases in this area.

Nine potential release sites were identified on or adjacent to this acquisition. Howe 1A was previously used as an auto wrecking yard. Adjacent sites of concern included former businesses (auto parts and repairs; paint manufacturing. and insecticide, paint store, Richfield Oil Co.) and current state and federal database sites.

- Property Acquisition Area No. 9 (Prospect 3 station alternative) – There are four release sites located in the vicinity of the acquisition. Two of the sites reported releases of TPH to soil. A third site reported a release, but no specific information was available concerning the nature of the release. The fourth site is reportedly the location of the former Seattle Lighting Company Coal Gas Plant. The exact location of the former coal plant is uncertain, but may be adjacent or within 300 feet of the acquisition. Station construction activities may encounter subsurface contamination due to the former coal plant.

Four potential release sites were identified on this acquisition. The Prospect 3 site was previously operated as a foundry business, possible fueling station, and truck storage facility. The site is currently occupied by a lumber business. Adjacent sites of potential concern include former businesses (bottling works, gas station, cabinet shop, print/paint shop, electric repair, welding,

warehouse) and current state and federal database sites, including a former coal gas plant. Station construction activities may encounter contamination due to the former businesses on the site.

- Property Acquisition Area No. 10 (Elliott and Mercer 1, 1A, and 2 station alternatives) – There are nine release sites on or adjacent to the acquisition. TPH appears to have affected the soil and groundwater in this area. Station construction activities may encounter contaminated soil and groundwater in this acquisition.

This acquisition area operated as a lumber supply facility in the past. Adjacent sites of potential concern include former businesses (auto repair, animal shelter, contractor storage, iron works, lumber company) and current state and federal database sites.

Additional documented and potential release sites along the alternative alignments in the Interbay Segment, but not included above in the acquisition discussions, are discussed below.

- *Alternative 2.1/2.1.2/2.2 (Ship Canal/Fishermen's Terminal to W Ruffner Street)*

Sediments in the Lake Washington Ship Canal near all of the Ballard Crossing alternatives appear to be contaminated with various chemicals. See Section 4.14.4. 1, Water, for more details on the types of contaminants and potential concentrations.

There were no identified documented release sites between the Fishermen's Terminal area and W Ruffner Street. The number of potential release sites along these alignment alternatives included three historical sites and one database site.

- *Alternative 2.1/2.1(s)/2.2 (W Ruffner Street to W Harrison Street)*

There are nine documented release sites on or adjacent to these two alternative alignments. One of these release sites is north of the C-1 Operations Center alternative near the Interbay Landfill. This site had a release of TPH to soil. The Interbay Landfill has a reported release of various compounds (solvents, metals, cyanide, pesticides, PAHs) to soil, groundwater, and surface water. It is possible the landfill may extend beneath both alternatives from W Bertona Street to W Armory Way along 15th Avenue W (see Figure 4.1-5). Construction of drilled shafts for the guideway in this area may encounter contaminated soil and groundwater, debris material (possible refuse), and methane gas.

The remaining seven sites are located in between the Howe and Prospect station acquisitions. These release sites involve contamination of both soil and groundwater. One of the release sites near the intersection of W Galer Street and 15th Avenue W has extracted and treated groundwater in the past. Construction of drilled shafts for the guideway in this area may encounter contaminated soil and groundwater.

The number of potential release sites along the alignment in this portion of Alternative 2.1, 2.1(s), and 2.2 included 23 database sites, 112 historical sites, and 26 reconnaissance sites.

The Preferred Alternative in the Interbay Segment includes three station alternatives (Dravus 1B, future Howe 1A, and Elliott and Mercer 1A), the C-1 Operations Center, and Alignment Alternative 2.1 on the west side of 15th Avenue W and center of Elliott Avenue W. The Preferred Alternative also includes some property acquisitions on the eastern side of Fishermen's Terminal. A summary of impacts for the Preferred Alternative is listed below.

Table 4.12-3. Total Documented and Potential Release Sites for the Preferred Alternative, Interbay/Magnolia Segment, Green Line

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Stations and Acquisitions:				
Fishermen's Terminal	2	5	0 ^c	0 ^c
Adjacent to Fishermen's Terminal	6 ^a	5	0 ^c	0 ^c
Dravus 1B	0	0	0	0
Adjacent Dravus 1B	5	1	11 ^a	1
C-1 Operations Center	0	0	5	0
Adjacent/C-1 Operations Center	3 ^a	2	2	4
Howe 1A	0	0	1	0
Adjacent Howe 1A	9 ^a	4 ^a	4	0
Elliott and Mercer 1A	0	0	1	0
Adjacent to Elliott and Mercer	9 ^a	8 ^a	17	0
Alignment:				
Alternative 2.1/2.1.1	9	23	107	24
Total	43	48	148	29

^a Some of these sites may be located on acquisition parcels.

Segments 3 and 4: Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments

There are nine groups of property acquisition parcels along this segment and they are all associated with station alternatives.

- Property Acquisition Area No. 11 (Seattle Center/Queen Anne 1, 1A, and 2 station alternatives) – There are two release sites on or immediately adjacent to the acquisition and three other release sites within 500 feet of the acquisition. The sites on or adjacent to the acquisition involved a release of TPH that affected soil and groundwater. Station construction activities may encounter contaminated soil and groundwater in this area. The three other release sites within 500 feet involved releases of TPH to soil and releases of TPH to soil and groundwater. One of these sites is located on the alignment west of the Seattle Center/Queen Anne station.

The only potential release site identified for this area is a former auto repair facility located adjacent to Seattle Center/Queen Anne 2.

- Property Acquisition Area No. 12 (Seattle Center/Fifth and Broad 1, 1A, and 2 station alternatives) – There are five release sites on or near this acquisition. One of the release sites appears to be on or immediately adjacent to the Seattle Center/Fifth and Broad 1 station acquisition with a reported release of TPH to soil. This site has received an NFA from Ecology in regards to this release. The other four release sites are within 200 to 300 feet of the acquisition and mainly had releases of TPH to soil. However, because TPH does not migrate significantly in

soil, most of these release sites have a lower potential to affect construction activities, except in the vicinity of the release site near Seattle Center/Fifth and Broad 1. It is possible that construction activities in this area may encounter residual TPH contamination.

Potential release sites located on Seattle Center/Fifth and Broad 1 include former businesses (dye works and electrical repair shop). Adjacent sites of potential concern include former businesses (gas station, junk yard, battery shop, auto repair, machinery shop) and current state and federal database sites. Potential release sites on Seattle Center/Fifth and Broad 1A included a gas and oil business. Adjacent sites of concern included former businesses (Dye Works; electrical repair shop; junk yard; auto repair; battery shop; garage with auto repair; and gas and oil). Potential release sites located on Seattle Center/Fifth and Broad 2 include former businesses (dye works and cleaners, a gas station with auto repair). Adjacent sites of concern to Seattle Center/Fifth and Broad 2 include former businesses (sheet metal) and current state and federal database sites. Station construction activities may encounter subsurface contamination in this area due to the former businesses.

- Property Acquisition Area No. 13 (Denny station alternative) – There are two release sites within 150 to 300 feet of this acquisition. One of the sites received an NFA from Ecology and the second site had a release, but the type of contaminant is unknown.

One potential release site located on the Denny site was a machinery company. Adjacent sites of concern included former businesses (gas stations), a current business (Union 76 Station), and current state and federal databases.

- Property Acquisition Area No. 14 (Belltown 1, 1A, 2, and 3 station alternatives) – There are six releases in the vicinity of this acquisition, each with a documented release of TPH to soil. Five of the sites are located 150 to 500 feet away and because TPH does not migrate significantly in soil, they have a lower potential to affect construction of the station alternatives. The sixth site is located on the alignment adjacent to the acquisition. It is indeterminate whether construction activities would be affected at this site. However, it is possible this site could affect construction of drilled shafts associated with the guideway.

Only one potential release site was identified for Belltown 1, 1A, and 3 (a machine shop). No potential release sites were identified for Belltown 2. Adjacent potential release sites included former businesses (engraving company, battery and electric company, used auto sales) and current state and federal database sites.

- Property Acquisition Area No. 15 (Fifth and Stewart 1, 1A, 2, 2A, and 3 station alternatives) – There are six release sites within 500 feet of the acquisition. One of the sites appears to be on or adjacent to Fifth and Stewart 2 with a reported release to soil (TPH, metals, cyanide, PAHs). It is possible that construction activities in this area may encounter soil contamination. Three of the remaining sites had a release to soil or soil and groundwater. The last two sites were dry cleaners, with one site reporting a release of solvents to soil and groundwater. These five sites are probably too far away to affect construction activities at the acquisition.

Potential release sites on the acquisition parcels included former businesses on Fifth and Stewart 1 and 2A (gas station) and on Fifth and Stewart 2 and 3 (drug store). Adjacent potential release sites included former businesses (gas stations, auto sales, millinery, type setting) and current state and federal database sites.

- Property Acquisition Area No. 16 (Pike 1A, 1B, 2, 2A, and 3 station alternatives) – There are six release sites within 500 feet of the acquisition. Five of the sites involved a release of TPH to soil and the sixth site was a surface (roadway) chemical spill. These six sites are considered too far

away to affect construction activities at the acquisition. However, four of them are located on the alignment and may impact construction activities along the guideway.

No potential release sites were identified for the acquisition. However, adjacent potential release sites include a former gas station.

- Property Acquisition Area No. 17 (Madison 1, 2, 2A, and 3 station alternatives) – There are five release sites within 500 feet of the acquisition. Four of the five sites have documented a release of TPH to soil or soil and groundwater. The fifth site is located adjacent to the acquisition along the alignment and involved a reported surface spill of hydraulic oil.

No potential release sites were identified for this acquisition. However, adjacent potential release sites included former businesses (gas stations) and current state and federal database sites.

- Property Acquisition Area No. 18 (Yesler 1 and 2 station alternatives) – Four release sites were identified on or within 500 feet of the acquisition. One of the sites appears to be located on the acquisition and has a documented release to soil and groundwater. Groundwater monitoring and site restoration has occurred in the past. The type of contamination was not reported. Station construction activities may encounter contaminated soil and groundwater in this area. The other release sites involved a diesel spill and a release to air during demolition work.

The Yesler 1 and 2 sites were previously occupied by a gas station. Adjacent potential release sites included state and federal database sites.

Additional release sites along alternative alignments in the Queen Anne/Seattle Center/Belltown and Downtown Segments, but not included above in the acquisition discussions, are discussed below.

- *Alternative 3.1/3.2 (W Harrison Street to First Avenue N)*

One release site was identified along the guideway near the intersection of Elliott Avenue W and W Harrison Street. This site had a release of TPH and PAHs to soil, groundwater, and surface water. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of Alternatives 3.1 and 3.2 included eight database sites and six historical sites.

- *Alternative 3.1 (First Avenue N to Thomas Street)*

No release sites were located on or immediately adjacent to the alternative.

- *Alternative 3.2 (First Avenue N to Thomas Street)*

Four release sites were identified along the guideway in this portion of the segment. Three of the release sites involved a release of TPH to soil. The fourth site reported a release of TPH, metals, and cyanide to soil and TPH to groundwater. Additional contaminants suspected at the site included solvents, PCBs, and asbestos. All four of these sites are on or immediately adjacent to the alignment. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in these areas.

The number of potential release sites along the alignment in this portion of Alternative 3.2 included four database sites and ten historical sites.

- *Alternative 3.3 (First Avenue N to Thomas Street)*

No documented release sites were located on or immediately adjacent to the alternative.

The number of potential release sites along the alignment in this portion of Alternative 3.3 included one database site and two historical sites.

- *Alternative 3.5 (First Avenue N to Cedar Street)*

One release site was identified adjacent to the alignment that had a reported release to soil. The contaminant type was not identified.

The number of potential release sites along the alignment in this portion of Alternative 3.5 included four database sites, 21 historical sites, and five reconnaissance sites.

- *Alternative 3.1, 3.2, 3.3, and 3.5/4.1, 4.1.1, 4.1.2, 4.2, 4.3, and 4.4 (Denny Way to S Jackson Street)*

One release site was identified near the intersection of Fifth Avenue and Wall Street, adjacent to the alignment. This site had a reported release of TPH to soil. Construction of drilled shafts for the guideway may encounter contaminated soil in this area. Three other release sites were located south of the Yesler station acquisition. One site had a release of TPH to soil and one was a transfer station with a release of TPH to groundwater and soil. The third site had a release of several chemicals (metals, cyanide, TPH, phenolics, PAHs) to groundwater and one or more of these to soil and surface water. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of the alternatives included 24 database sites, 24 historical sites, and four reconnaissance sites.

The Preferred Alternative in the Queen Anne/Seattle Center/Belltown and Downtown Segments includes seven station alternatives (Seattle Center/Queen Anne 1A, Seattle Center/Fifth and Broad 1A, Belltown 1A, Fifth and Stewart 2A, Pike 1 (Option B), Madison 1, and Yesler 1), and Alignment Alternatives 3.1, 3.1.4, 3.2, 4.1, and 4.1.2. A summary of impacts for the Preferred Alternative is listed below.

Table 4.12-4. Total Documented and Potential Release Sites for the Preferred Alternative, Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments, Green Line

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Stations:				
Seattle Center/Queen Anne 1A	0	0	0	0
Adjacent /Seattle Center/Queen Anne 1A	5 ^a	0	1	0
Seattle Center/Fifth and Broad 1A	0	0	1	0
Adjacent /Seattle Center/Fifth and Broad 1A	0	0	3	0
Belltown 1A	0	0	2	0
Adjacent /Belltown 1A	6	2	7	0
Fifth and Stewart 2A	0	0	1	0

**Table 4.12-4. Total Documented and Potential Release Sites for the Preferred Alternative, Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments, Green Line
(continued)**

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Adjacent/Fifth and Stewart 2A	6	3	2 ^a	1
Pike 1B	0	0	0	0
Adjacent/Pike 1B	6	0	1 ^a	0
Madison 1	0	0	0	0
Adjacent/Madison 1	5	4 ^a	2 ^a	0
Yesler 1	1	0	1	0
Adjacent/Yesler 1	3	4 ^a	2 ^a	0
Alignment:				
Alternative 3.1/3.1.4/3.2/4.1/4.1.2	9	36	40	4
Total	41	49	63	5

^a Some of these sites may be located on acquisition parcels.

^b There are a total of six documented release sites adjacent to Fifth and Stewart 1, 2, and 3. Segment 5: SODO/Chinatown International District/Pioneer Square Segment.

There are seven groups of property acquisitions in this segment. The acquisition areas are associated with the station and operation center alternatives, and are also associated with land needed in different areas of the SODO segment.

- Property Acquisition Area No. 19 (Weller/King Street station alternative) – One site with a release of TPH to soil and groundwater was identified on or adjacent to the acquisition. The exact location of the release on the site is unknown. Station and guideway construction activities may encounter subsurface contamination in this area. Two other release sites were located 300 to 400 feet from the acquisition with releases of TPH and other chemicals to soil and groundwater. One of these sites is a solid waste transfer station. These other two sites are likely too far away to affect construction activities on the acquisition.

Potential release sites on or near the acquisition area included former railroad tracks and railroad structures and a regulatory database site. The most likely contaminants associated with railroad operations are petroleum compounds.

- Property Acquisition Area No. 20 (S Weller Street to S Royal Brougham Way) – There are seven documented release sites near this acquisition. Most of the sites involve releases of TPH to soil and groundwater. Guideway construction activities may encounter contamination in this area.

Potential release sites on or adjacent to the acquisition included former businesses (railroad, garage, cold storage) and current state and federal database sites.

- Property Acquisition Area No. 21 (Safeco Field station alternative) – Four release sites were identified within approximately 200 feet of the acquisition. Two reported releases of TPH to soil and the other two sites reported releases of TPH to soil and groundwater.

A gas station and truck parking area were previously located on this acquisition site. Station and guideway construction activities may encounter subsurface contamination in this area. Adjacent potential release sites include former businesses (auto repair/storage, bulk oil, grocery, steel companies, work shops, ice cream factory, truck/loading area with elevator), current businesses (Metro bus garage, industrial center, cold storage), and a regulatory database site.

- Property Acquisition Area No. 22 (S Atlantic Street to S Holgate Street) – There are six documented release sites on or near this acquisition. All of these sites involve a release of TPH to soil or groundwater or both. Guideway construction activities may encounter contamination in this area.

Potential release sites on or adjacent to this acquisition include former businesses (paint, carpentry, boiler, tool factory, dairy, furniture, fuel storage, auto repair, rental, plumbing, storage), current businesses (oil, mobile services, other commercial), and state and federal database sites.

- Property Acquisition Area No. 23 (Third Avenue S and S Lander Street) – There are ten documented release sites in the vicinity of this acquisition. Two of these sites may be on the acquisition and involve releases of TPH and other chemicals (PCBs, solvents) to soil and groundwater. Guideway construction activities may encounter contamination in this area. The remaining eight sites involve releases of TPH to soil and groundwater.

Potential release sites on or adjacent to this acquisition included former businesses (gas, auto repair, truck repair), and state and federal database sites.

- Property Acquisition Area No. 24 (Lander 1, 2, 3, and 4, C-2 Operations Center Alternatives) – Seven release sites were identified on or near the acquisition parcel areas. Two of the release sites appear to be on the C-2 Operations Center site, and reported releases of TPH to soil and soil and groundwater. Three of the release sites appear to be located immediately adjacent to the Lander 2 (Southwest) station acquisition. These sites reported releases of TPH to soil and groundwater. Groundwater monitoring may be ongoing at one of these sites. The remaining two release sites are located near the Lander 1 and 3 acquisitions, one of the sites reporting release of TPH to soil. The nature of the release from the second site is unknown. Station and Operations Center construction activities may encounter soil and groundwater contamination in these areas.

Potential release sites on the acquisition parcels include former businesses on Lander 1 and 3 (plumbing supplies, warehouse, furniture, pipe shop, electrical supplies), Lander 2 (brass foundry, machine shop, electric shop), and Lander 4/C-2 Operations Center (steel company, possible petroleum facility). Adjacent potential release sites include former businesses (gas stations, pipe shops, plumbing supplies, electrical supplies, furniture, paint, auto transfer depot, machinery, warehouse, steel company, electric shop, welding, department store, foundry) and current state and federal database sites.

- Property Acquisition Area No. 25 (S Horton Street) – There are eight documented release sites in the vicinity of this acquisition. Two of the sites may be on the acquisition and involve releases of metals and petroleum compounds to soil, groundwater, and surface water. Guideway construction activities may encounter contamination in this area. The other sites involve releases of TPH to soil and groundwater.

Potential release sites on or adjacent to this acquisition included former businesses (machine shop, foundry, auto parts, coal warehouse, motor repair, paint, junkyard, warehouse, airplane warehouse, steel fabricating, boiler, lumberyard), current businesses (machine shop, warehouse, cement warehouse, other commercial/industrial properties), and state and federal database sites.

Additional documented and potential release sites along the alternative alignments in the SODO Segment but not included above in the acquisition discussions, are discussed below.

- *Alternatives 5.1/5.2/5.2(s) (S Jackson Street to S King Street)*

There are four release sites in the vicinity of the guideway in this portion of the segment. Three of the sites involve a release of TPH to soil and groundwater. Release information was not available for the remaining site.

Potential release sites were not identified for this portion of the alignment.

- *Alternatives 5.1/5.2/5.2(s) (S Holgate Street to S Stacy Street)*

There are four documented release sites adjacent to the guideway in this portion of the segment. The release sites appear to be closer to Alternative 5.1 than Alternative 5.2/5.2(s). The sites involve releases of TPH or TPH plus other compounds (metals, cyanide, PCBs, solvents). The media affected include soil, groundwater, and surface water. Construction of drilled shafts for the guideway may encounter contaminated material in this area.

Potential release sites include eight historical sites and seven reconnaissance sites.

- *Alternatives 5.1.1/5.1.2 (S Lander Street to S Hanford Street)*

There are no documented release sites on or immediately adjacent to this portion of the segment.

Potential release sites for Alternative 5.1.1 included 12 historical sites, eight reconnaissance sites, and seven database sites. Potential release sites for Alternative 5.1.2 included 24 historical sites, 10 reconnaissance sites, and three database sites.

The Preferred Alternative in the SODO Segment includes three station alternatives (Weller/King Street 2, Safeco Field 1, and Lander 3, and Alignment Alternative 5.2(s). The Preferred Alternative will also include some property acquisitions in the vicinity of the Weller/King Street Station, Safeco Field Station, Lander Station Area, and the S Horton Street area near the end of the segment. A summary of impacts for the Preferred Alternative is listed below.

Table 4.12-5. Total Documented and Potential Release Sites for the Preferred Alternative, SODO/Chinatown International District/Pioneer Square Segment, Green Line

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Stations:				
Weller/King Street Station 2	1	0	1	0
Adjacent/Weller/King Street Station 2	2	1	0	0
S Weller Street to S Royal Brougham Way	0	0	0	0
Adjacent/Weller to Royal Brougham	7 ^a	3 ^a	1 ^a	0
Safeco Field 1	0	0	2	0
Adjacent/Safeco Field 1	4	1	10	4
S Atlantic Street to S Holgate Street	0	0	0	0

Table 4.12-5. Total Documented and Potential Release Sites for the Preferred Alternative, SODO/Chinatown International District/Pioneer Square Segment, Green Line (continued)

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Adjacent/Atlantic to Holgate	6 ^a	5 ^a	23 ^a	8 ^a
Third Avenue S and S Lander Street	0	0	0	0
Adjacent/Third and Lander	10 ^a	10 ^a	19 ^a	9 ^a
Lander 3	0	0	8	0
Adjacent/Lander 3	2 ^b	0	4	0
S Horton Street	0	0	0	0
Adjacent/S Horton Street	8 ^a	10 ^a	19 ^a	9 ^a
Alignment:				
Alternative 5.2(s)	4	0	8	7
Total	44	30	95	37

^a Some of these sites may be located on acquisition parcels.

^b These two release sites are adjacent to both Lander 1 and 3.

Segment 6: West Seattle Segment

There are five groups of property acquisition parcels in this segment. These acquisitions are associated with station alternatives and land needed in the Terminal 25 area near the West Seattle Bridge.

- Property Acquisition Area No. 26 (Terminal 25) – There are 11 documented release sites on or near this acquisition. Three of these sites are on the acquisition or immediately adjacent and have releases of TPH and metals to soil and groundwater. Construction activities in this area may encounter contaminated material. The remaining eight sites are within 500 feet of the acquisition with releases of TPH and other chemicals to soil, groundwater, and surface water. These eight sites have a lower potential to affect the acquisition of the station parcels but may affect construction activities along the guideway in these areas.

Potential release sites included former businesses (auto freight depot, machine shop/blacksmith, paint, carpenter), current businesses (maintenance, auto, manufacturing), and current state and federal regulatory database sites.

- Property Acquisition Area No. 27 (Delridge 3 station alternative) – There are three documented release sites on or near this acquisition. Two of these release sites are on the acquisition or immediately adjacent and have releases of TPH, metals, cyanide, PCBs, and PAHs to soil and groundwater. Construction activities in this area may encounter contaminated material. The third release site is within 400 feet of the acquisition with a reported release of TPH to soil.

Potential release sites on or adjacent to Delridge 3 include former businesses (gas station, steel mill), current businesses (steel mill), and state and federal database sites.

- Property Acquisition Area No. 28 (Delridge 1, 1A, 2 and 4 station alternatives) – There are five release sites in this area, all associated with steel companies. TPH has been released to soil at most of the sites. TPH plus other compounds (metals, cyanide, solvents, phenolic compounds, PAHs, PCBs) have been released to soil, groundwater, sediments, and surface water at some of the sites. One of the release sites was a cooling pond that received an NFA from Ecology in

1994. The cooling pond site appears to be located in the vicinity of the Delridge 1, 1A and 2 station areas. Another one of the release sites appears to be on or adjacent to the Delridge 4 station alternative. The release site is a steel company that has 17 RCRA violations and is monitoring groundwater. Station construction activities may encounter contaminated soil and groundwater in the area of Delridge 1, 1A, 2, and 4.

Adjacent potential release sites include steel mills (former and current).

- Property Acquisition Area No. 29 (Avalon 1, 2A and 2B station alternatives) – There are four release sites on or in the vicinity of the acquisition. Two of these release sites are on or immediately adjacent to the Avalon 1 station and each reported a release of TPH to soil and groundwater. The other two release sites are adjacent to the Avalon 2A and 2B stations and each reported releases of TPH to soil. Station construction activities may encounter contaminated soil and groundwater in this area.

Potential release sites on or adjacent to Avalon 1 include former businesses (gas stations, auto repair, used auto sales) and state and federal database sites. Potential release sites on or adjacent to Avalon 2A and 2B include former businesses (cabinet shop) and current businesses (furniture store, convenience store, dry cleaner, lumber yard), and a state and federal database site.

- Property Acquisition Area No. 30 (Alaska Junction 1, 1A, and 2 station alternatives) – Only one release site was identified within 500 feet of this acquisition. The site is located approximately 300 feet from the acquisition parcels and reported a release of TPH to soil.

Potential release sites on Alaska Junction 1 and 1A include former businesses (auto wrecking, veterinary hospital). No potential release sites were identified for Alaska Junction 2. Adjacent potential release sites for Alaska 1, 1A, and 2 include former businesses (sheet metal, paint, gas station and auto repair), current businesses (dry cleaners, print shop), and current state and federal database sites.

- Property Acquisition Area No. 31 (Morgan Junction 1, 1A, and 2) – Three documented release sites are located in the vicinity of this acquisition. All three involve releases of TPH to soil and groundwater. One of the sites also involves a release of solvents. Station construction activities may encounter contaminated soil and groundwater in this area.

Potential release sites on Morgan Junction 1 and 1A include current businesses (auto repair) and former businesses (auto store, paint store). Potential release sites on Morgan Junction 2 include a current gas station. Adjacent properties of potential release include former businesses (gas station, coal and wood yard, upholstery), current business (dry cleaners), and observations of concern (groundwater monitoring wells located north of Morgan Junction 2).

Additional release sites along the alternative alignments in the West Seattle Segment, but not included above in the full-acquisition discussions, are discussed below.

- *Alternatives 6.1, 6.1(s), 6.1.1, 6.1.1(s), 6.1.2, 6.1.2(s), 6.2 (S Horton Street and Colorado Avenue S to West Side of West Seattle Bridge)*

There are 12 release sites on or adjacent to the alignments in this portion of the segment. These sites involved releases of TPH to soil and groundwater and a suspected release of solvents and pesticides to soil and groundwater. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of the segment included 10 database sites, 26 historical sites, and 3 reconnaissance sites.

- *Alternatives 6.1/6.2/6.4/6.4(s) (West side of West Seattle Bridge to Avalon Station Area)*

Three release sites were identified on or adjacent to the alignment in this portion of the segment. Two of the sites involved a release of TPH and solvents to soil and groundwater. The third site involved a release of TPH to soil. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of Alternatives 6.1 and 6.2 included two database sites.

- *Alternative 6.3(s) (West side of West Seattle Bridge to SW Yancy Street and SW Avalon Way)*

There are four release sites on or adjacent to the alignment in this portion of the segment. Three of the release sites involved a release of TPH to soil and the fourth site received a NFA from Ecology. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of the segment includes two database sites.

- *Alternative 6.5 (Delridge Way SW and SW Andover Street to SW Genesee Street and SW Avalon Way)*

There are no identified release sites on or immediately adjacent to the alignment in this portion of the segment. There is one potential release site (database site) near the beginning of the Alternative at SW Andover Street and Delridge Way SW.

- *Alternative 6.1.3/6.1.4 (Avalon Station area to 39th Avenue SW and SW Alaska Street)*

There are five release sites on the alignment in this portion of the segment. All of the sites involve releases of TPH to one or more of the following media types: soil, groundwater, and surface water. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment in this portion of Alternatives 6.1.3 and 6.1.4 included six database sites and 17 historical sites.

- *Alternative 6.2, 6.2.1, 6.2.2 (Avalon Station Area to 39th Avenue SW and SW Alaska Street)*

There are no identified release sites directly on the alignment in this portion of the segment. There are two sites near the alignment along 37th Avenue SW with reported releases of TPH to soil.

The number of potential release sites along the alignment in this portion of Alternatives 6.2, 6.2.1, 6.2.2 included three database sites, five historical sites, and three reconnaissance sites.

- *39th Avenue SW and SW Alaska Street to Alaska Junction 1 Station Area*

There are four release sites identified near the intersection of 39th Avenue SW and SW Alaska Street. All of these sites involve a release of TPH to soil. No other release sites were identified along this portion of the segment. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater near the intersection of 39th Avenue SW and SW Alaska Street.

The number of potential release sites along the alignment included four database sites, eight historical sites, and two reconnaissance sites.

- *Alaska Junction Station Area to Morgan Junction Station Area*

One release site was identified adjacent to the alignment alternatives just south of the Alaska Junction area. This site had a reported release of TPH to soil. Construction of drilled shafts for the guideway may encounter contaminated soil and groundwater in this area.

The number of potential release sites along the alignment included two database sites and 24 historical sites, and one reconnaissance site.

The Preferred Alternative in the West Seattle Segment includes four station alternatives (Delridge 3 (Nucor), Avalon 2B, Alaska Junction 1, and Morgan Junction 1A), and Alignment Alternatives 6.1.1(s), 6.3(s), 6.2.2, 6.1, and 6.1.6(s). The Preferred Alternative also includes property acquisitions associated with Terminal 25. A summary of impacts for the Preferred Alternative is listed below.

Table 4.12-6. Total Documented and Potential Release Sites for the Preferred Alternative, West Seattle Segment, Green Line

Preferred Alternative and Location	Documented EDR Release Sites	Potential Release Sites		
		EDR Sites	Historical Sites	Reconnaissance Sites
Stations and Acquisitions:				
Terminal 25	0	0	0	0
Adjacent/Terminal 25	11 ^a	8 ^a	6 ^a	4 ^a
Delridge 3	0	1	1	1
Adjacent/Delridge 3	3 ^a	0	1	0
Avalon 2B	0	0	1	0
Adjacent/Avalon 2B	2	1	1 ^a	4
Alaska Junction 1	0	0	2	0
Adjacent/Alaska Junction 1	1 ^b	2	4	2
Morgan Junction 1A	0	0	2	1
Adjacent/Morgan Junction 1A	1	0	2	1
Alignment:				
Alternative 6.1.1(s)/6.3(s)/6.2.2/6.1/6.1.6(s)	21	21	90	9
Total	39	33	110	22

^a Some of these sites may be located on acquisition parcels.

^b There is one documented release site near Alaska Junction 1 and 2.

4.12.4.3 No Action Alternative

Under the No Action Alternative, the Green Line would not be constructed and no known release sites would be affected by construction activities. Contamination that would be remediated or controlled during construction of the Green Line would remain and could migrate. Without construction of the Green Line, several industrial properties would not be cleaned up and developed. Transforming unused and/or contaminated properties into usable land is a great benefit to the public and the environment. In addition, potential existing sources of contamination (e.g., heating oil tanks) may not be removed and could leak at a later date and affect the environment. The soil and groundwater monitoring plan would also include a discussion of Best Management Practices to be employed when hazardous materials are encountered or suspected.

4.12.5 Mitigation

4.12.5.1 Operation

Standard operating procedures (SOPs) would be developed for use at the Operations Center to address management of hazardous materials as part of the Green Line operation. SOPs could include:

- Health and safety plan
- Worker training program
- Materials use planning and tracking
- Documentation protocol
- Waste management program
- Spill control plan

A trained quality assurance/health and safety officer would oversee implementation of the SOPs.

Handling procedures for hazardous materials would include:

- Lubricants - Stored in an area where spills are contained. Used in small quantities to minimize the impact of a spill. Used lubricants are captured and recycled by local waste-disposal firms.
- Solvents - Stored in "explosion-proof" rooms/cabinets. Used in small quantities to minimize the impact of a spill. Used in well-ventilated areas in accordance with federal and state occupational safety regulations.
- Fuels - Stored in an area where spills are contained and that is equipped with fire-suppression systems. The fueling facility for the Maintenance & Recovery Vehicle (MRV) will be located separate from other maintenance work areas. Fueling for automotive vehicles (if provided) will be in accordance with federal and state regulations for fire safety and spill control.
- Detergents - Only materials that may be drained into the City's sewer system will be used. If detergent quantities in the vehicle wash water exceed allowable limits, the water will be recycled.
- Refrigerants - Only EPA-approved refrigerants will be used. These will be stored, handled, recaptured, and disposed of in accordance with federal regulations.
- Dust - The generation of hazardous material dust will be minimized through (1) limiting the use of such materials and (2) avoiding activities that create it. Where the generation of airborne dust is unavoidable, such as cleaning vehicle brakes or minor repairs to vehicle body panels, equipment will be utilized to capture the dust for proper disposal.
- Fumes - Fumes may be generated by certain maintenance activities, such as welding. Generally, these will be very small amounts. Equipment will be provided to capture and remove these fumes from the maintenance work area in accordance with federal and state occupational safety regulations.

4.12.5.2 Construction

Planning documents to assist with construction and demolition activities along the Green Line would be developed prior to commencement of these activities. The planning documents could include a health and safety program and a hazardous materials management plan. The purpose of the health and safety program would be to protect and minimize exposure of the public and site workers to hazardous materials during demolition and construction. Hazardous materials (e.g., asbestos, lead-based paint, PCB-light

ballasts) could be encountered during demolition of structures. Work plans prepared as a part of the health and safety program will address handling of hazardous building materials prior to and during demolition. More information on the types of structures along the Green Line is presented in Section 4.11, Cultural Resources. The purpose of the hazardous materials management plan would be to specify procedures for contaminated soil identification, stockpiling, transportation, disposal, and treatment elements, as well as groundwater removal, storage, treatment, discharge, transportation, and disposal elements. The hazardous materials management plan would also include Best Management Practices that would be employed for temporary storage of excavated material.

Avoiding the areas of concern identified in the vicinity of the Green Line could minimize potential impacts. By avoiding or limiting exposure to potentially hazardous materials, the project would benefit in the following ways:

- Reduce the risk of exposing site workers and the public to hazardous materials.
- Reduce the possibility of increased construction costs and construction delays.
- Reduce the liability associated with remediation and ownership of contaminated property.

Implementation of remedial activities during or prior to construction of the Green Line could reduce potential long-term impacts from contaminated properties. In contrast, avoiding all contaminated properties would minimize the opportunity for cleaning up sites and creating beneficial impacts.

Acquisition parcels with residual contamination exceeding regulatory standards or negotiated cleanup levels would be identified in the documentation provided to Ecology. Restrictive covenants on contaminated properties that need to be acquired for the Green Line may be necessary to provide for property transfers and to limit future subsurface work and site activities.

During the course of this project, other properties may need to be acquired such as construction lay-down areas and possible sites for electrical substations. These parcels should be evaluated for potential environmental concerns prior to acquisition or temporary use.

4.12.6 Significant Unavoidable Adverse Impacts

Significant unavoidable adverse impacts to environmental health from construction could be avoided by implementing the health and safety program and hazardous materials management plan mentioned above in Section 4.12.5.2.

4.12.7 Electric and Magnetic Fields

For the purposes of this EIS, EMF refers to electric and magnetic fields associated with the use of extremely low frequency electric power.¹ The energy fields surrounding sources of electrical power are divided into two categories, electric fields and magnetic fields. Electric fields are produced by voltage, or “electrical pressure” and the potential to do work. A lamp plugged in but not turned on may emit an electric field. Electric field strength is measured in volts per meter (V/m). Magnetic fields occur when current flows through wires or electrical devices. A lamp that is plugged in and turned on may exhibit both electric and magnetic fields. Magnetic fields in the United States are typically measured in units of gauss (G),² which increases with the current (typically measured in amps). Both electric and magnetic fields rapidly decrease in intensity as the distance from the source increases (Central Link 1999).

¹ Extremely low frequency electric and magnetic fields: 3 to 3,000 Hz. In this frequency range, electric and magnetic fields are not interrelated like they are at higher frequencies, in which case they may be called “electromagnetic fields.”

² Internationally, magnetic fields are measured in tesla (T) units; 1 T = 10,000 G.

There is no conclusive evidence showing a link between EMF of the type and level associated with monorail and other types of transit and adverse human health effects. EMF associated with the existing Seattle electric bus system has not been associated with any type of adverse effects. Once a system is chosen, electric and magnetic field intensities will be confirmed and compliance with applicable standards will be ensured. For additional information on EMF, see Appendix S Environmental Health Backup Information in the Draft EIS.

4.13 EARTH

This section describes the affected environment, impacts, and mitigation options for the Green Line with respect to the earth element of the environment. The affected environment section describes the setting of the proposed project and provides a baseline of information to assist with the evaluation of potential impacts to the Green Line. The impact section identifies and evaluates the potential effect that the existing geologic conditions (physiography (physical features), geological units, groundwater, and geologic hazards) may have on the operation of the Green Line, and evaluates how the operation of the Green Line could affect the geologic conditions along the route. The mitigation section evaluates options to reduce or eliminate potential impacts from operation of the Green Line. Construction impacts and mitigation options to reduce or eliminate construction impacts for earth are presented in Section 4.17, Construction.

The results of the Earth section are based upon a literature review and field reconnaissance of the Green Line alternative alignments. All sources referenced in this section are listed in Appendix HH, References. The field reconnaissance involved walking and driving the alignment and visually examining potential environmental hazards.

4.13.1 Affected Environment

The purpose of the affected environment section is to describe the geologic setting of the Green Line alternative alignments so as to provide a baseline for evaluating potential impacts. The components of the geologic setting that were evaluated include the physiography of the area, geologic units, groundwater, and geologic hazards. The discussion below is divided into a general discussion of the geologic setting, followed by a more detailed discussion of the geologic setting in each of the six segments.

4.13.1.1 Physiography and Regional Geology

The physiography of Seattle is characterized by a series of elongated ridges, drift uplands, and Pleistocene glacial troughs (Galster and Laprade 1991; Sabol et al. 1988). These troughs are now occupied by bodies of water and associated lowlands (Puget Sound, Duwamish-Green Rivers, and Lake Washington). The physiographic units within the Seattle area were shown on Figure 4.13-1 of the Draft EIS and are not included in the Final EIS because the information has not changed. Geology in the region consists of a thick sequence of glacially consolidated soils overlying bedrock. Between periods of glaciations, the valleys and low-lying areas filled with river and lake sediments (Galster and Laprade 1991). Generalized cross sections depicting subsurface conditions in the vicinity of the Green Line alternative alignments were shown in Figure 4.13-2 of the Draft EIS and are not included in the Final EIS because the information has not changed. The locations of the geologic sections were shown on Figure 4.13-3 of the Draft EIS and are not included in the Final EIS because the information has not changed. The surficial geologic units identified in the area of the Green Line route include artificial fill, Recent or Holocene deposits, and Pleistocene deposits. Artificial fill material and recent deposits are present over a significant portion of the Green Line and overlie older glacial deposits. The general distribution of these units was shown in Figure 4.13-4 of the Draft EIS and is not included in the Final EIS because the information has not changed.

4.13.1.2 Geologic Hazard Areas

Geologic hazard areas were identified by the City of Seattle (2002) in the vicinity of the Green Line alternative alignments, and these include steep slopes/landslide hazards and liquefaction zones (areas of loose soil that could turn into a highly unstable, jelly-like substance during an earthquake). Landfills were also reviewed as a geologic hazard because of potential impacts from subsurface landfill materials.

The general locations of these hazards were shown on Figures 4.13-5 through 4.13-9 of the Draft EIS and are not included in the Final EIS because the information has not changed. In addition, the general location of the Seattle fault zone was added to the figures based upon prior geotechnical studies completed for the Green Line (Shannon & Wilson 2001a) and geologic work conducted by the University of Washington and the U.S. Geologic Survey (Booth et al. 2002; Troost et al. 2003).

4.13.1.3 Analysis of the Segments and Alignment Alternatives

The following discussion is based upon a review of available information developed by the City of Seattle, King County, and University of Washington and geotechnical studies conducted for the Green Line. A large portion of the Green Line would be constructed within the street right-of-way. Subsurface materials in most areas within the six segments would likely contain fill material associated with utility trenches and road improvements.

Segment 1: Ballard Segment

The conditions described below for the Ballard Segment apply to all of the following alternatives: 1.1 (West Side of 15th), 1.1(s) (West Side of 15th single beam), 1.2 (Center of 15th), 1.1.1 (West Bridge), 1.1.1(s) (West Bridge single beam), 1.1.2 (Far West Bridge), and 1.2 (East Bridge). Because of the close proximity of the alternatives, the available data on soils and geology do not support differentiation of geologic conditions by alternative alignment.

Land surface elevations in the Ballard area range from approximately 330 feet above mean sea level (MSL) at the northernmost point of the Green Line project to 25 feet MSL near Salmon Bay and the Ballard Bridge. There is a downward slope in this area from north to south. The Green Line alignment alternatives are mostly located in the Ballard Trough, with Phinney Ridge to the east and Sunset Hill to the west.

The surficial geology has been mapped in this area as predominantly glacial till (City of Seattle 1999; Booth et al. 2002). Soil borings in this area have shown fill material at the surface overlying glacial deposits (Shannon & Wilson 2001c). The fill material consists of sand, silt, and clay, with some cobbles and boulders, mixed with debris (such as brick, concrete, rubble, and sawdust). The fill ranges in thickness from five to 15 feet and appears to be thickest near Salmon Bay. Subsurface conditions underlying the Ballard area generally consist of five to 15 feet of fill material overlying glacial outwash (medium dense to dense sand, gravelly sand, and sandy gravel) and till (very dense silty gravelly sand).

The subsurface units beneath the Lake Washington Ship Canal consist of approximately 10 to 20 feet of very soft Holocene depression fillings overlying five to 10 feet of medium-dense to very-dense recessional outwash deposits (Seattle Popular Transit Plan Programmatic EIS 2002).

Depth to first encountered groundwater appears to range from seven to 16 feet below grade in this area (Shannon & Wilson 2001c).

There are no mapped geologic hazards on or adjacent to the Green Line in the Ballard Segment (see Figure 4.13-4 in the Draft EIS). However, there are reportedly loose surficial fill soils near the north bank of Salmon Bay, making this area susceptible to liquefaction (Shannon & Wilson 2001c).

Segment 2: Interbay/Magnolia Segment

The conditions described below for the Interbay/Magnolia Segment apply to all of the following alternatives: 2.1 (West Side of 15th/Center of Elliott), 2.1(s) (West Side of 15th/Center of Elliott single beam), 2.2 (Center of 15th/West Side of Elliott), 2.1.1 (West Bridge Connection), and 2.1.2 (Far West

Bridge Connection). Because all alternatives are in relatively close proximity, the available data on soils and geology do not support differentiation of geologic conditions by alternative alignment.

All Green Line alignment alternatives follow the Interbay Channel between the Magnolia Drift Upland to the west and Queen Anne Hill to the east. The alternatives are located at the base of Queen Anne Hill for most of this segment. Elevations in this area range from approximately 20 to 75 feet MSL.

The surficial geology in the Interbay area where the Green Line alignment alternatives are located is mapped as mostly fill and to a lesser extent Pleistocene clay deposits (City of Seattle 1999; Booth et al. 2002). In general, fill (sand, silt, and clay, with some cobbles and boulders, mixed with debris), alluvial (loose to dense layers of silt, silty sand, and gravelly sand), and landslide deposits (loose to soft, disturbed mixture of several types) overlie denser non-glacial and glacial deposits (Seattle Popular Transit Plan Programmatic EIS 2002). The former Interbay Landfill is located along 15th Avenue W, and some of the fill material in this vicinity is refuse (Parametrix 2000). Available mapping of the extent of refuse indicates that the following Green Line alignments and features could pass over or through the landfill: Alternatives 2.1, 2.1(s), and 2.2 between approximately W Bertona and W Boston Streets, and the C-1 Operations Center Alternative.

Depth to first encountered groundwater is highly variable in this area. Depths range from approximately five to 40 feet below ground surface (Parametrix 2000; Shannon & Wilson 2001e).

The mapped geologic hazards in this section include liquefaction zones, potential slide zones, slide areas, steep slopes and landfills (see Figure 4.13-5 in the Draft EIS). The liquefaction zones are present beneath most of the Green Line alignment alternatives in this segment. The potential slide zones, slide areas, and steep slopes are indicated immediately adjacent to most of the east side of the Interbay/Magnolia Segment, at the base of Queen Anne Hill. A documented landslide has been mapped on the Interbay alignment approximately 300 feet southeast of the proposed Prospect 3 (West) station. Municipal landfill deposits (Interbay Landfill) have been mapped beneath Alternatives 2.1, 2.1(s), 2.2, Dravus Stations 1, 1A, 1B, and 2, and the C-1 Operations Center.

Segments 3 and 4: Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments

The Green Line alignment alternatives in the vicinity of Seattle Center are located south of Queen Anne Hill and the Lake Union Depression. Elevations range from 25 to 100 feet MSL. The topography in this area generally slopes to the west. Elevations farther to the south in the Central Business District also range from 25 to 100 feet MSL. The topography in the Central Business District also generally slopes to the west.

The surficial geology in the Seattle Center/Downtown area is mapped as either glacial deposits or fill material (City of Seattle 1999). Subsurface data show this area to be underlain by fill material, landslide deposits, and glacial deposits (Seattle Popular Transit Plan Programmatic EIS 2002; Shannon & Wilson 2001b). Geologic conditions beneath the Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments vary with location. Given these changing geologic conditions and the complexity of alternative alignments and stations, Table 4-13-1 is presented to summarize anticipated soil and geologic conditions beneath these segments.

Groundwater was encountered in both the fill deposits and glacial deposits. Depth to groundwater ranges from approximately five to 45 feet (Seattle Popular Transit Plan Programmatic EIS 2002; Shannon & Wilson 2001b).

Table 4.13-1. Anticipated Soil and Geologic Conditions Beneath Alignment and Station Alternatives in the Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments

Segment Alternative/Feature	Anticipated Geologic Unit	Geologic Unit Description
Alignment Alternatives		
3.1 - Seattle Center/Republican	Glacial till	Very dense mixture of gravelly silty sand; also known as hardpan
	Fill	Sand, silt, and clay, with some cobbles and boulders, mixed with debris (such as brick, concrete, rubble, and sawdust)
3.2 – Mercer	Glacial till	See above
3.3 – Thomas	Glacial till	See above
3.5 - Second/Denny	Glacial till	See above
4.1 - West Side of Second	Glacial till	See above
	Glacial outwash	Medium dense to dense sand, gravelly sand, sandy gravel, and till (very dense silty gravelly sand)
	Glaciomarine deposits	Mixture of very dense to hard clay and silt with some sand, gravel, cobbles, and boulders
4.1.1 - Route to Fifth and Stewart (Northwest)	Glacial till	See above
4.1.2 - Route to Fifth and Stewart (Virginia)	Glacial till	See above
4.2 - East Side of Second with Crossover	Fill	See above
	Glacial outwash	See above
	Glaciomarine deposits	See above
4.3 - Center of Second	Fill	See above
	Glacial outwash	See above
	Glaciomarine deposits	See above
4.4 – East of Center of Second with Crossover	Fill	See above
	Glacial outwash	See above
	Glaciomarine deposits	See above
Station Alternatives		
Seattle Center/Queen Anne 1 and 1A (North)	Glacial till	See above
Seattle Center/Queen Anne 2 (South)	Glacial till	See above
Seattle Center/Fifth and Broad 1 and 1A (Southeast)	Fill	See above
Seattle Center/Fifth and Broad 2 (Harrison)	Glacial till	See above
Denny 3	Fill	See above
Belltown 1, 1A, 2, and 3	Fill	See above
Fifth and Stewart 1, 1A, 2, 2A, and 3	Fill	See above
Pike 1A, 1B, 2, 2A, and 3	Fill	See above
Madison 1, 2, 2A, and 3	Glacial outwash	See above
Yesler 1 and 2	Glaciomarine deposits	See above

Note: Soil and geologic conditions in the Ballard, Interbay/Magnolia, and SODO Segments are explained in the text.

Source: Shannon & Wilson (2001b); City of Seattle (1999).

Liquefaction zones are indicated near the Green Line alignment alternatives near Yesler Way and at the northern end near W Harrison Street and Elliott Avenue W. The potential hazard area near Yesler Way is a relatively limited, shallow liquefaction zone. The W Harrison Street/Elliott Avenue W area is susceptible to liquefaction due to loosely dumped fill material in this vicinity. The embankment on the southwest corner of Memorial Stadium is a mapped steep slope critical area according to City of Seattle GIS maps. Only Alternative 3.1 (Seattle Center/Republican) passes through this steep slope area.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Most of the SODO Segment is located in the Duwamish Valley physiographic province. This area is mostly flat with elevations at approximately 20 to 25 feet MSL.

Fill material is present at the surface throughout the entire length of the SODO Segment (City of Seattle 1999). Generally, the fill material is underlain by recent sedimentary deposits and glacial deposits (Seattle Popular Transit Plan Programmatic EIS 2002; Shannon & Wilson 2001a). Fill thickness was generally about 10 feet, although up to 25 feet of fill was observed in some borings drilled on or near the SODO Segment.

Depth to first encountered groundwater can be shallow in this segment. Geotechnical borings in this area encountered groundwater at depths ranging from four to 16 feet below grade (Shannon & Wilson 2001a).

Geologic hazards mapped for this segment include liquefaction zones beneath the entire SODO Segment alignment and the Seattle fault zone between S Forest and S Hanford Streets, near the south end of the proposed C-2 Operations Center (see Figure 4.13-7 in the Draft EIS). The actual location of the fault zone is being studied by the University of Washington and the U.S. Geological Survey, and should be considered approximate. Landslide hazards were not shown on maps of this area (City of Seattle 2002a,b,c).

Segment 6: West Seattle Segment

The Green Line West Seattle Segment alternatives would cross Harbor Island and the Duwamish Waterway and pass through or by the northernmost part of Pigeon Point. The alignment alternatives then cross over Longfellow Creek and rise to the West Seattle Drift Upland. Elevations range from 25 feet MSL near the Duwamish Waterway to 325 feet MSL on the West Seattle Drift Upland.

The surface geologic units that characterize the West Seattle Drift Upland include glacial till and advance outwash deposits (City of Seattle 1999; Troost et al. 2003). The glacial deposits may be overlain by 5 to 20 feet of very loose to moderately dense fill material (Shannon & Wilson 2001f). The geologic units that characterize the area of the segment between the West Seattle Drift Upland and the Duwamish Waterway include fill material overlying alluvial and glacial deposits (Shannon & Wilson 2001f). Geologic conditions beneath the West Seattle Segment alternatives vary with location. Given these changing geologic conditions and the complexity of alternative alignments and stations, Table 4.13-2 is presented to summarize anticipated soil and geologic conditions beneath the West Seattle Segment.

Most of the borings from the geotechnical studies on the West Seattle Drift Upland did not encounter groundwater (Shannon & Wilson 2001f). However, a review of Ecology well logs showed groundwater at 17 to 22 feet below grade near the southern end of the Green Line route in West Seattle (Ecology Well Log Files 2003). Depth to groundwater between the Upland and the Duwamish Waterway ranged from approximately 2 to 40 feet below grade (Shannon & Wilson 2001f).

Significant geologic hazards on or near the West Seattle Segment include splays of the Seattle fault, liquefaction zones, and steep slopes. The Seattle fault crosses Alternatives 6.1, 6.1(s), 6.2, 6.3(s), 6.4, and

6.4(s) as follows: just north of SW Andover Street and the Delridge stations 1, 1A, and 2; at SW Genesee Street (Alternative 6.5), just north of Avalon stations 1, 2A, and 2B; and between SW Juneau and SW Raymond Streets. The University of Washington and the U.S. Geological Survey have modified the mapped location of the fault zone in this area and show it crossing Alternatives 6.1, 6.2, 6.1.6, and 6.1.6(s) between SW Alaska Street and SW Hudson Street. Liquefaction zones are present beneath Alternatives 6.1, 6.1(s), 6.1.1, 6.1.1(s), 6.1.2, 6.1.2(s), 6.2, 6.3(s), 6.4, and 6.4(s) from the start of the West Seattle Segment to the vicinity of the intersection of SW Avalon Way and SW Yancy Street. Steep slopes are also present near or under all of the alternatives as they pass up the hill from the Duwamish River past Pigeon Point, and at limited locations between Pigeon Point and the terminus at Morgan Junction.

Table 4.13-2. Anticipated Soil and Geologic Conditions Beneath Alignment and Station Alternatives in the West Seattle Segment and Associated Green Line Features

Segment Alternative/Feature	Anticipated Geologic Unit	Geologic Unit Description
Alignment Alternatives		
6.1/6.1(s) - West Seattle I	Fill	Sand, silt, and clay, with some cobbles and boulders, mixed with debris (such as brick, concrete, rubble, and sawdust)
	Glaciolacustrine deposits	Silt and clay
	Alluvium	Very loose to very dense layers of sand, silty sand, and gravelly sand
	Glacial till	Very dense mixture of gravelly silty sand; also known as hardpan
	Glacial outwash	Medium dense to dense sand, gravelly sand, sandy gravel and till (very dense silty gravelly sand)
6.1.1/6.1.1(s) - Past Pigeon Point	Fill	See above
	Glaciolacustrine deposits	Stiff to hard silty clay
6.1.2/6.1.2(s) - To Pigeon Point	Fill	See above
	Glaciolacustrine deposits	Silt and clay
6.1.3 - Northwest Side of Fauntleroy	Glacial till	See above
	Glacial outwash	Sand and silt
6.1.4 - Southeast Side of Fauntleroy	Glacial till	See above
	Glacial outwash	See above
6.1.6 – West Side of California 6.1.6(s) – West Side of California single beam	Fill	See above
	Glaciolacustrine deposits	See above
	Glacial till	See above
	Glacial outwash	See above
6.2 – West Seattle II	Fill	See above
	Glaciolacustrine deposits	See above
	Alluvium	See above
	Glacial till	See above
	Glacial outwash	See above
6.2.1/6.2.2 – North Side of Alaska to 35 th	Fill	See above
	Glaciolacustrine	See above

Table 4.13-2. Anticipated Soil and Geologic Conditions Beneath Alignment and Station Alternatives in the West Seattle Segment and Associated Green Line Features (continued)

Segment Alternative/Feature	Anticipated Geologic Unit	Geologic Unit Description
6.3(s) – Delridge North Subsegment	Glacial till	See above
	Glacial outwash	See above
	Fill	See above
	Glaciolacustrine deposits	See above
	Alluvium	See above
	Glacial till	See above
6.4/6.4(s) –Andover/Yancy Subsegment	Glacial outwash	See above
	Fill	See above
	Glaciolacustrine deposits	See above
	Alluvium	See above
	Glacial till	See above
6.5 – Genesee Subsegment	Glacial outwash	See above
	Fill	See above
	Glaciolacustrine deposits	See above
	Alluvium	See above
	Glacial till	See above
	Glacial outwash	See above
Station Alternatives		
Delridge 1, 1A, 2, 3, and 4	Alluvium	See above
Avalon 1 (Center)	Glacial till or outwash	See above
Avalon 2A and 2B (35 th)	Glacial till	See above
Alaska Junction 1 and 1A (42 nd /Edmunds)	Glacial till or outwash	See above
Alaska Junction 2 (44 th /California)	Glacial outwash	See above
Morgan Junction 1 and 1A (West)	Glacial outwash	See above
Morgan Junction 2 (Center)	Glacial outwash	See above

Note: Soil and geologic conditions in the Ballard, Interbay, and SODO Segments are explained in the text.

Source: Shannon & Wilson (2001b); City of Seattle (1999); Troost et al. (2003).

4.13.2 Impacts

This section evaluates the potential effect that the existing geologic conditions may have on the operation of the Green Line. In addition, this section also evaluates how operation of the Green Line could affect geologic conditions along the route. Refer to Section 4.17, Construction, for discussion of construction-related impacts and mitigation.

One hazard type that affects all of the segments is seismic hazards. The Uniform Building Code (ICBO 1997) has rated Puget Sound in Seismic Zone 3, which is an area with moderate to high seismic activity. Based on this information, the entire Green Line may be impacted by earthquake shaking and should be considered to have a moderate to high seismic risk.

4.13.2.1 Operational Impacts

Operational impacts would be those associated with the daily operation of the Green Line trains, such as vibrations, but these impacts are likely to be negligible (for more information on Noise and Vibration, see Section 4.7). Operational impacts are discussed below in terms of how geologic conditions could affect the Green Line.

Segment 1: Ballard Segment

The potential hazards for the Ballard Segment include the general seismic hazard that applies to the entire Green Line noted above and liquefaction near the Ballard Bridge.

The risk for liquefaction applies to all of the alternatives. The City of Seattle did not map liquefaction hazards along the Green Line alternatives for this segment, but geotechnical studies for the area indicated the potential for liquefaction near the Ballard Bridge where fill material is approximately 15 to 20 feet thick (Shannon & Wilson 2001c). The effects of liquefaction may include loss of bearing capacity for shallow foundations, reduction in lateral and vertical capacities of deep foundations, ground surface settlements, and lateral spreading (Shannon & Wilson 2001c).

Landslide hazards are not shown on geologic hazard maps of the area and are therefore not a concern. Risks of ground rupture from the Seattle fault zone are expected to be low given the distance from Ballard to the northernmost extent of the fault zone (approximately eight miles) (Shannon & Wilson 2001c).

The Preferred Alternative in the Ballard Segment includes three station alternatives (Crown Hill 1A, NW 65th 1B, and NW Market 3A) and Alignment Alternative 1.1(s) (West of 15th single beam) and West Bridge 1.1.1. The potential impacts described above would also apply to the Preferred Alternative. Because of the close proximity of the Preferred Alternative with the other alternatives, the available data on geologic hazards do not support differentiation of impacts by alternative alignment.

Segment 2: Interbay/Magnolia Segment

There are several geologic hazard areas that could affect all of the Interbay Segment alternatives (2.1, 2.1(s), 2.1.1, 2.1.2, and 2.2, which are closely aligned), due to an abundance of loose fill materials and recent deposits and the close proximity to Queen Anne Hill. The potential geologic hazards that could affect the Green Line Interbay Segment alternatives in this area include the general seismic hazard that applies to the entire Green Line, liquefaction of loose material, landfill debris, steep slopes, and landslides.

It is estimated that the upper 40 to 50 feet of soil beneath or immediately adjacent to all of the Interbay Segment alternatives (including stations and the Operations Center) could experience liquefaction. The effects of liquefaction may include loss of bearing capacity for shallow foundations, reduction in lateral and vertical capacities of deep foundations, ground surface settlements, and lateral spreading (Shannon & Wilson 2001e).

Of particular concern is the mapped presence of municipal landfill deposits (former Interbay Landfill) beneath Alternatives 2.1, 2.1(s), 2.2, the Dravus stations 1, 1A, 1B, and 2, and the C-1 Operations Center. The fill material in this area may contain a variety of debris and obstructions, especially near the Interbay Landfill located along 15th Avenue W. The depth of the refuse at the landfill is variable, with a maximum depth of approximately 50 feet (Shannon & Wilson 1994). The refuse material is within the zone of liquefaction described above. The decomposition of the refuse at the landfill is producing methane gas, which has migrated off the site underneath 15th Avenue W in the past (Parametrix 2000). Gas probes

were installed in February 1999 on the east side of 15th Avenue W between W Barrett Street and W Wheeler Street by the City of Seattle because methane had been detected in utility trenches in this vicinity (Parametrix 2000). The City of Seattle installed gas extraction wells in October 1999 at the landfill to prevent migration of methane across 15th Avenue W (Parametrix 2000). The fill material in this area and the potential presence of methane gas could cause difficulties during installation of drilled shafts for the guideway and stations. Explosive levels of methane gas could also accumulate in enclosed spaces associated with structures. Recent investigation by CDM of the potential Operations Center site, however, shows no evidence of refuse or combustible gas (Peterson 2003).

The potential exists for earthquake-induced landslides and landslides due to heavy rainfall to impact the Green Line on the western slope of Queen Anne Hill, which lies near the eastern boundary of all of the Interbay Segment alternatives (Shannon & Wilson 2001e). The area of concern is east of 15th Avenue W and Elliott Avenue W near the base of Queen Anne Hill. In addition, the Green Line Alternatives 2.1, 2.1(s), and 2.2 cross a mapped landslide at the southern end of the segment near Elliott Avenue W and W Mercer Place.

Risks of ground rupture from the Seattle fault zone are expected to be low given the distance from Interbay to the northernmost extent of the fault zone (approximately four miles) (Shannon & Wilson 2001e).

The Preferred Alternative in the Interbay Segment includes three station alternatives (Dravus 1B, Howe 1A (future), Elliott and Mercer 1A), the C-1 Operations Center, and Alignment Alternative 2.1 (West of 15th/Center of Elliott). The potential impacts described above would also apply to the Preferred Alternative. Because of the close proximity of the Preferred Alternative with the other alternatives, the available data on geologic hazards do not support differentiation of impacts by alternative alignment.

Segments 3 and 4: Queen Anne/Seattle Center/Belltown and Downtown/Pioneer Square Segments

The potential hazards for the Queen Anne/Seattle Center/Belltown and Downtown Segments include the general seismic hazard that applies to the entire Green Line, liquefaction zones, and steep slopes.

Liquefaction zones are a concern with respect to impacts on the alternatives from loss of soil stability in an earthquake. The mapped liquefaction zones in this segment could potentially affect Alternatives 3.1 and 3.2 near the northern end of the Seattle Center segment by W Harrison Street at Elliott Avenue W, and Alternatives 4.1 and 4.2 near the southern end of the Downtown Segment by Yesler Way. The effects of liquefaction may include loss of bearing capacity for shallow foundations, reduction in lateral and vertical capacities of deep foundations, ground surface settlements, and lateral spreading (Shannon & Wilson 2001e).

There is a potential for slope instability on the steep slope near Memorial Stadium. A steep slope hazard has also been mapped near Alternative 3.5 (Second/Denny).

Risks of ground rupture from the Seattle fault zone are expected to be low given the distance from this area to the fault zone (approximately 1.5 miles) (Shannon & Wilson 2001e).

The Preferred Alternative in the Queen Anne/Seattle Center/Belltown and Downtown Segments includes seven station alternatives (Seattle Center/Queen Anne 1A, Seattle Center/5th and Broad 1A, Belltown 1A, Fifth and Stewart 2A, Pike 1, Madison 1, and Yesler 1) and Alignment Alternatives 3.1, 3.1.3, 3.2, 4.1, and 4.1.2. The potential impacts described above would also apply to the Preferred Alternative. Because of the close proximity of the Preferred Alternative with the other alternatives, the available data on geologic hazards do not support differentiation of impacts by alternative alignment. Two exceptions are

the steep slope hazard along Alternative 3.1 (part of the Preferred Alternative) near Memorial Stadium and the steep slope hazard adjacent to Alternative 3.5 (Second/Denny).

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The potential hazards for the SODO Segment include the general seismic hazard that applies to the entire Green Line, liquefaction zones, and fault rupture.

Liquefaction zones are mapped throughout all the alternatives of this segment (5.1, 5.1.1, 5.1.2, 5.2, and 5.2(s)), as well as station sites and the C-2 Operations Center. Therefore, the potential for liquefaction is similar for all alternatives based on available mapping. The soils susceptible to liquefaction in this segment include fill materials plus some alluvial soils. The effects of liquefaction may include loss of bearing capacity for shallow foundations, reduction in lateral and vertical capacities of deep foundations, ground surface settlements, and lateral spreading (Shannon & Wilson 2001a).

The Seattle fault zone crosses the alignment of Alternatives 5.1.1 and 5.1.2 and the south end of the C-2 Operations Center between S Lander and S Hanford Streets. The actual location of the fault zone is being studied by the University of Washington and the U.S. Geological Survey, and should be considered to be approximate. Evidence of seismic activity suggests that there was a rupture along the Seattle Fault approximately 1,100 years ago, with a recurrence interval of approximately several thousand years. The actual risk to the Green Line in the vicinity of the Seattle fault zone is relatively high if a 2,500-year return period is considered for design. The risk of fault rupture decreases to low to moderate if a 475-year return period is used (Shannon & Wilson 2001a). The 2,500 year return period has a higher level of risk because it is more likely that an earthquake will occur during this time interval as opposed to the shorter 475 year return period.

The Preferred Alternative in the SODO Segment includes three station alternatives (Weller/King Street 2, Safeco Field 1, and Lander 3) and Alignment Alternative 5.2(s) (West of Third/West of Utah single beam). The potential impacts described above would also apply to the Preferred Alternative. Because of the close proximity of the Preferred Alternative to the other alternatives, the available data on geologic hazards do not support differentiation of impacts by alternative alignment.

Segment 6: West Seattle Segment

The potential hazards for the West Seattle Segment include the general seismic hazard that applies to the entire Green Line, liquefaction zones, steep slopes/landslides, and fault rupture.

The area between the Duwamish Waterway and the base of the West Seattle Drift Upland is susceptible to the effects of liquefaction. Liquefaction is a concern for all the alternatives (6.1/6.1(s), 6.1.1, 6.1.2, 6.1.6/6.1.6(s), 6.2, 6.3(s), 6.4/6.4(s), and 6.5) in this area. Alternative 6.2 may be more susceptible to liquefaction than the other alternatives near Pigeon Point. The effects of liquefaction may include one or more of the following: loss of bearing capacity for shallow foundations, reduction in lateral and vertical capacities for deep foundations, ground surface settlements, and lateral spreading (Shannon & Wilson 2001a).

Landsliding is a concern near Pigeon Point (City of Seattle 2002a,b,c) and would mostly affect Alternative 6.1.2. The Pigeon Point area would not be affected by Alternative 6.1.1 or 6.2. Landsliding is also a concern along part of Alternative 6.3 and 6.3(s), the Preferred Alternative in this area.

The Seattle fault crosses Alternatives 6.1, 6.2, 6.3 and 6.4 as follows: just north of SW Andover Street and the Delridge stations 1, 1A, and 2; at SW Genesee Street (Alternative 6.5), just north of Avalon

stations 1, 2A, and 2B; and between SW Juneau and SW Raymond Streets. The University of Washington and the U.S. Geological Survey have modified the mapped location of the fault zone in this area and now show it crossing Alternatives 6.1 and 6.2 between SW Alaska Street and SW Hudson Street. Evidence of seismic activity suggests that there was a rupture along the Seattle Fault approximately 1,100 years ago, with a recurrence interval of approximately several thousand years. The actual risk to the Green Line for the area between the Duwamish Waterway and the base of the West Seattle Drift Upland is relatively high if a 2,500-year return period is considered for design. The risk of fault rupture decreases to low to moderate if a 475-year return period is used (Shannon & Wilson 2001a). The risk to the Green Line from ground rupture of the Seattle fault zone on the West Seattle Drift Upland portion of the segment is expected to be relatively low (Seattle Popular Transit Plan Programmatic EIS 2002).

The Preferred Alternative in the West Seattle Segment includes four station alternatives (Delridge 3, Avalon 2B, Alaska Junction 1, Morgan Junction 1A) and portions of Alignment Alternatives 6.1(s), 6.1.6(s), 6.2.2, and 6.3(s). Due to the complexity of the geologic setting and the varied location of alternatives, Table 4.13-3 is presented to summarize the geologic hazards that could potentially impact the Preferred Alternative and the other alternatives.

Table 4.13-3. Identified Geologic Hazards Along the Preferred Alternative and Other Alternatives, Segment 6 (West Seattle)

Segment Alternative/Feature	Geologic Hazard
Preferred Alternative Alignments	
6.1(s) - West Seattle I	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
6.1.6(s) - West Side of California Single Beam	Fault Rupture
6.2.2 - North Side of Alaska to 35th	Adjacent to Landsliding/Steep Slopes, Fault Rupture
6.3(s) - Delridge North Subsegment	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
Preferred Alternative Stations	
Delridge 3	Liquefaction, Fault Rupture
Avalon 2B	Adjacent to Landsliding/Steep Slopes, Fault Rupture
Alaska Junction 1	Fault Rupture
Morgan Junction 1A	Fault Rupture
Other Alternative Alignments	
6.1 - West Seattle I	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
6.1.1 - Past Pigeon Point	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
6.1.2/6.1.2(s) - To Pigeon Point	Liquefaction, Landsliding/Steep Slopes, Fault Rupture

Table 4.13-3. Identified Geologic Hazards Along the Preferred Alternative and Other Alternatives, Segment 6 (West Seattle) (continued)

Segment Alternative/Feature	Geologic Hazard
6.1.3 - Northwest Side of Fauntleroy	Fault Rupture
6.1.4 - Southeast Side of Fauntleroy	Fault Rupture
6.1.6 - West Side of California	Fault Rupture
6.2 - West Seattle II	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
6.2.1 - North Side of Alaska to 35th	Adjacent to Landsliding/Steep Slopes, Fault Rupture
6.4/6.4(s) - Andover/Yancy Subsegment	Liquefaction, Fault Rupture
6.5 - Genesee Subsegment	Liquefaction, Landsliding/Steep Slopes, Fault Rupture
Other Alternative Stations	
Delridge 1, 1A and 2	Liquefaction, Fault Rupture
Delridge 4	Fault Rupture
Avalon 1	Fault Rupture
Avalon 2A	Adjacent to Landsliding/Steep Slopes, Fault Rupture
Alaska Junction 1A and 2	Fault Rupture
Morgan Junction 1 and 2	Fault Rupture

4.13.2.2 No Action Alternative

Under the No Action Alternative, no impacts are expected.

4.13.3 Mitigation

The purpose of the mitigation section is to evaluate options for reducing or eliminating the operational impacts associated with geologic conditions. Mitigation options associated with construction impacts are presented in Section 4.17, Construction.

Mitigation Options for Seismic Hazards (Liquefaction and Fault Rupture):

- Seismic criteria for the design and construction of the Green Line will meet all applicable City of Seattle and State of Washington Seismic Design Criteria and the applicable provisions of the International Building Code. Specific citations for design criteria and building codes will be determined prior to design.
- All Green Line system facilities, including stations and guideways, will meet applicable State and City codes for safety during earthquakes. Specific citations for state and city codes will be determined prior to design.
- The SMP is conducting geotechnical studies that will consider probabilistic seismic hazard analysis, which will be further addressed through appropriate design for the project. The geotechnical studies to support design include Seattle fault rupture simulation, site-specific ground-motion response studies, and ground motion incoherency (Shannon and Wilson 2001d,e,f). This could also include an analysis of seismic response for any dissimilar abutting structures at stations.

- Liquefaction and lateral spreading could be mitigated by designing structures to resist displacements and induced lateral loads and/or improving subsurface soils to mitigate the potential for liquefaction. Structural design to resist vertical and horizontal displacement and lateral loads typically requires stiff foundation elements, such as large-diameter piles or drilled shafts, to reduce deflection of the structure to tolerable limits. Site conditions and economical design often result in a combination of deep foundations and ground improvements at a given site. Soil improvement techniques may include densification by vibration (e.g., vibro-replacement stone columns, compaction grouting); grouting and admixtures (e.g., jet grouting, deep mixing); and vibration and drainage (e.g., earthquake drains).

Mitigation Options for Landslide Hazards:

- Mitigation for landslide hazards is only required where construction activities are in existing landslide hazard areas. Potential mitigation measures include using an engineered structure (retaining wall), regrading the slope to an allowable inclination, and installing drainage improvements (US DOT 1998). Additional mitigation measures to reduce the potential for landslides could also include improving groundcover in susceptible areas.

4.13.4 Significant Unavoidable Adverse Impacts

By using appropriate seismic criteria as required by City and State building codes to design Green Line guideways, foundations, stations, and other structures, there should be no significant unavoidable adverse impacts caused to earth by the Green Line operation. Landslides could be a significant unavoidable adverse impact in areas where the Green Line is on or immediately adjacent to slide-prone areas. However, constructing retaining walls at the base of slide-prone areas could reduce the potential for this type of impact.

4.14 WATER

4.14.1 Introduction

This section compares the operational impacts of the Green Line alternatives and the No Action Alternative on the aquatic environment, including both water quantity and water quality. In addition to effects of the proposal and its alternatives, possible methods to avoid, minimize, or mitigate those effects are also discussed. This section examines potential impacts to water quality and quantity from the operation of the Green Line. Water-related impacts due to construction of the Green Line and associated mitigation measures are discussed in Section 4.17.15. No impacts to groundwater would be expected because it is not anticipated that operational stormwater would be discharged through groundwater infiltration. Even if operational stormwater were discharged through infiltration, it would be discharged in compliance with all applicable federal, state, and local requirements and in compliance with groundwater quality standards. This section first describes potential impacts that are common among all the alternatives, and then describes impacts that would be unique to one or more alternatives on an alternative-by-alternative basis. Section 4.15, Plants and Animals, examines the impacts of the proposed action on plant and animal resources.

The Washington State Department of Ecology (Ecology) has indicated that SMP may be required to obtain an individual National Pollutant Discharge Elimination System (NPDES) permit issued for stormwater discharges associated with construction activities. That permit will be conditioned to comply with water quality standards. SMP will also be required to obtain a Section 401 Water Quality Certification from Ecology prior to issuance of the U. S. Coast Guard permit for the construction of the Ballard Crossing over the Ship Canal and construction of a guideway on the West Seattle Bridge or a new, monorail-only bridge over the Duwamish. The Section 401 Certification will contain conditions that will provide reasonable assurance that water quality standards will be met. Before the system becomes operational, an NPDES operational permit would be required for any stormwater discharges to surface water associated with industrial activities. The Green Line project will also have to comply with City of Seattle stormwater regulations.

The Green Line would be constructed primarily on land that has already been developed with impervious surface. Neither construction nor operation of the Green Line would require structures in any wetland areas. However the alternatives immediately south of Nucor Steel (6.1, 6.2 and 6.4) may require one or more columns to be placed within a wetland buffer. Descriptions of wetlands south of Nucor Steel and potential construction impacts and mitigation measures are provided in Appendix RR – Longfellow Creek Wetland Report. No alternative requires any wetland filling or would have any significant impact to wetlands. The Preferred Alternative (6.3(s) Delridge North single beam) would not be located near the wetlands and would not have any impact on the wetlands or their buffers.

4.14.2 Statutory and Regulatory Overview

Activities in and near surface water are subject to laws and regulations at the federal, state, and local levels.

4.14.2.1 Federal Regulations

The federal Clean Water Act (CWA) of 1972 and its amendments regulate discharges to surface waters. Unless otherwise noted, references to the CWA include all reauthorizations and amendments since the law's original passage. This law provides guidelines and financial assistance for identifying and resolving water quality problems and establishes standards and regulations for protecting the quality and beneficial uses of the nation's waterways. The CWA regulates "navigable waters," also known as

“waters of the United States.” Federal agencies responsible for enforcing the CWA include the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE).

Sections of the CWA that apply to surface waters associated with the Green Line project include Section 401 (water quality certification), Section 402 (NPDES permits), and Section 404 (dredging or filling navigable waters of the United States).

Other applicable federal statutes include the Rivers and Harbors Act for work in navigable waters, the National Environmental Policy Act (NEPA) for actions requiring an environmental assessment when federal funding or permits are required, and the Coastal Zone Management Act (CZMA) for the protection of coastal resources and the development of shoreline management plans. The entire Green Line area is within the defined CZMA Coastal Zone, which includes all of King County. The CZMA includes compliance with Washington State’s Shoreline Management Act, Washington State’s Clean Air Act, SEPA, Washington State’s Clean Water Act, and the Energy Facilities Siting Act. Wildlife and plant species listed as federally threatened or endangered and their critical habitat, including streams and wetlands, are protected under Section 7 of the Endangered Species Act of 1973.

4.14.2.2 Washington State Statutes and Regulations

Implementation and enforcement for some of the sections of the CWA, including Sections 401 and 402, have been delegated to Ecology.

The Washington State Water Pollution Control Act, RCW 90.48, states Washington’s policy, “to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington.”

Water Quality Standards

As required by the CWA, Washington has set water quality standards to protect the beneficial uses of surface waters. The standards vary with classification of the surface water body (WAC 173-201A). Ecology assigns the classifications, which include AA (extraordinary), A (excellent), B (good), C (fair), and Lake Class. Water quality standards reflect the state’s desired level of water quality, and not necessarily existing water quality conditions. The state regulations specify that otherwise unclassified water bodies be classified based on the water body into which they discharge. Class AA waters are regulated by the state to support desired beneficial uses, including but not limited to water supply, stock watering, fish, wildlife habitat, recreation, commerce, and navigation.

Fresh and marine water quality standards have been established for fecal coliform bacteria (an indicator of fecal contamination), dissolved oxygen, total dissolved gas, temperature, pH, turbidity, aesthetics, and toxic, radioactive, and deleterious materials. Water quality standards for the classifications of water bodies potentially affected by this project are included in Appendix T of the Draft EIS.

Ecology recently adopted new State Surface Water Quality Standards, which create use-based standards instead of the current class-based standards. Various water quality criteria such as temperature have been revised, and the revised rule contains anti-degradation requirements. Ecology has submitted Washington’s new surface water quality standards to EPA for approval. According to Ecology, these new standards are not applicable for projects requiring federal permits until the standards are approved by EPA. As part of the permitting for this project, SMP will obtain a construction stormwater NPDES

permit, which will be conditioned so that the project complies with applicable state surface water quality standards.

Under Section 303(d) of the CWA, Ecology is also responsible for identifying impaired waters that do not meet surface water quality standards. The list of such impaired waters, known as the 303(d) list, must include a priority ranking for each water body, taking into account the severity of the pollution and the uses to be made of such waters. For waters identified in the 303(d) list, the CWA requires states to establish total maximum daily loads (TMDLs) that ensure attainment of water quality standards. Ecology's assessment of which waters are to be placed on the 303(d) list is guided by federal law, Washington State's Water Quality Standards, and Washington 303(d) policy. This policy describes, among other things, how the standards are applied, requirements for data use, and how to prioritize TMDLs. The most recent Washington State 303(d) list may be viewed at www.ecy.wa.gov/programs/wq/303d/index.html. Washington State has also adopted groundwater quality standards that protect groundwater. The standards are found at WAC 173-200.

Stormwater Discharge

Ecology also administers Section 402(p) of the CWA, which regulates the discharge of stormwater from construction sites larger than one acre into a receiving surface water body, either directly or via a storm drain system. The receiving water may be wetlands, ditches, creeks, rivers, lakes, marine waters, or estuaries (Ecology 2001). The stormwater management plan for the Green Line would be consistent with the guidance outlined in the 2001 *Stormwater Management Manual for Western Washington* (Ecology Manual). Section 402(p) of the CWA also regulates stormwater discharges associated with industrial activity.

Sediments

Ecology has developed sediment quality management regulations (WAC 173-204 Sediment Management Standards). Ecology has not specified freshwater sediment criteria. Sediments removed for disposal during construction would be designated as solid, dangerous, hazardous, or extremely hazardous waste; removal would be completed in accordance with Washington State Dangerous Waste Regulations (WAC 173-303). Pre-construction sampling would identify the general nature of the sediment chemical contaminants to allow for project design. Additional sediment sampling would be completed following sediment excavation to determine the sediment's specific regulatory status to allow for a final determination of disposal requirements. Sediment classified as non-dangerous solid waste would be disposed of at a Subtitle D municipal landfill. Sediment that is classified as dangerous, hazardous, or extremely hazardous waste would be disposed of at a Subtitle C landfill.

The type and concentration of chemical constituents would determine the treatment or containment methods that would be required by the disposal facility. If sediment does not contain leachable constituents or other Underlying Hazardous Constituents at concentrations greater than 10 times the Universal Treatment Standards (40 CFR 268.48), then the sediment may be disposed of at a Subtitle C landfill without further treatment. If the sediment does contain leachable constituents, or other Underlying Hazardous Constituents, at concentrations greater than 10 times the Universal Treatment Standards, then the material may require treatment prior to disposal. The final decision of the need for treatment would be determined by the disposal facility according to their permit requirements.

Transportation of waste materials, including dangerous waste, would be according to Specification Section 02210 3.05, 49 CFR Part 172, WAC 173-303, DOT protocols and regulations, and/or other applicable federal, state, and local regulations.

Contaminated sediments would be disposed of at any of several facilities located in south central Washington or northern Oregon. Currently, several facilities have obtained approval to receive sediments containing free liquids, in accordance with their permit requirements thereby eliminating the need for on-site sediment dewatering. Stockpiled sediment that does not exceed the dangerous waste concentration (WAC 173-303-090) or landfill requirements for metals or other constituents would be disposed of at a Subtitle D landfill.

Sediments may also be characterized in accordance with the Washington State Dredged Material Management Program (DMMP) protocols. This characterization may determine that all or part of the dredged sediments are non-contaminated and suitable for open-water disposal per DMMP guidelines. The DMMP represents a coordinated multi-agency approach to management of dredged materials in the State of Washington. The cooperating agencies include the U.S. Army Corps of Engineers – Seattle District, U.S. Environmental Protection Agency – Region 10, and the Washington Departments of Ecology and Natural Resources. By statutory requirement, the Washington State Department of Natural Resources (DNR), “provides, manages and monitors aquatic land disposal sites on state-owned aquatic lands for material dredged from rivers, harbors, and shipping lands.” DNR is responsible for management and environmental monitoring of eight unconfined open-water dredged material disposal sites around Puget Sound.

DNR, in consultation with other DMMP agencies, is responsible for conducting regularly scheduled environmental monitoring events at its open water disposal sites to verify that DMMP management guidelines are adequately protecting the environment against unacceptable adverse impacts. These monitoring events confirm whether deposited materials remain within the disposal site boundaries, the cleanliness of the materials disposed at the site, and the effect of dredged materials on local aquatic life.

Aquatic Lands

Washington State Department of Natural Resources (DNR) is responsible for managing publicly owned aquatic lands. DNR evaluates impacts to aquatic lands as part of their easement authorization process.

4.14.2.3 Local Regulations

The City of Seattle has local jurisdiction over this project. In accordance with the City’s municipal NPDES permit, the project will be required to undergo a Comprehensive Drainage Review by the City. The Comprehensive Drainage Control Plan will be designed in accordance with the Seattle Stormwater Code. Stormwater flow control and water quality treatment requirements are discussed under Water Quantity and Water Quality mitigation later in this section. The City will require review and approval of work in or near identified sensitive or critical areas, such as streams and wetlands. The resource must be evaluated, its value classified, and the project impacts assessed. Generally, development activities are restricted from occurring within streams and their designated buffers; however, minor modifications to the sensitive areas may be allowed if compensated by approved mitigation measures.

4.14.3 Methodology

4.14.3.1 Methodology for Affected Environment

Section 4.14.4, Affected Environment (Surface Quantity/Quality) begins by providing a discussion of existing surface water bodies potentially affected by the Green Line alternative alignments. A discussion of Seattle’s drainage system, which conveys runoff from the project area to the receiving water bodies, is also provided.

4.14.3.2 Methodology for Operation

Section 4.14.5, Operation evaluates the operational impacts of the Green Line on receiving water bodies. This section is further subdivided into a water quality discussion and a water quantity discussion. Construction-related water quality impacts are discussed in Section 4.17.15.

Operational Water Quality Analysis

Water quality issues concern pollutants that can be transported by stormwater when precipitation strikes a surface containing contaminants. The contaminants can become suspended in the stormwater and transported to receiving water bodies. Potential water quality impacts associated with operation of the Green Line are analyzed by measuring the amount of surface area that a project would add to an existing site, which has the potential to allow pollutants to come into contact with precipitation.

To compare the potential water quality impacts between proposed alternatives, an analysis was done to quantify the amount of pollution generating impervious surface (PGIS) added or removed by each station and Operations Center alternative, and a typical traction power substation site. Typical concentrations of pollutants found in roadway runoff are included in order to link the change in PGIS to estimated quantities of pollutants that could be expected to be carried away via stormwater. Existing PGIS was estimated from aerial photographs. Anticipated PGIS with each facility was estimated from conceptual site plans. These site plans are conservatively large and likely overestimate the amount of PGIS that would be created.

Methods of mitigating potential water quality impacts are also discussed. Although the impacts are analyzed by measuring the difference in PGIS before and after the project, potential mitigation is evaluated based only on the amount of PGIS that would be created by the Green Line, regardless of the existing site conditions. This method of mitigation is required by local and state regulations. Pursuant to the *Seattle Stormwater Treatment Technical Requirements Manual*, the six-month, 24-hour storm volume was estimated using StormShed™ modeling software by Engenious Systems, Inc. to predict the volume of stormwater for which a water quality facility would need to be designed. Treatment volumes were calculated for each of the station sites that would require water quality mitigation, the Operations Centers, and a typical traction power substation site.

Operational Water Quantity Analysis

Water quantity issues are associated with the volume and velocity of stormwater runoff. The water quantity discussion in this section describes potential impacts to receiving water bodies and Seattle's stormwater and combined sewer conveyance systems due to increases in stormwater runoff quantity that could result from the Green Line alternatives. The effects on surface water bodies due to changes in stormwater runoff rate and quantity are analyzed based on the change in the amount of impervious surface that would result from the project. While this method does not directly measure the impacts to the affected environment, it provides a reasonable basis to evaluate the Green Line alternatives. Changes in impervious surfaces were determined by calculating the difference between existing impervious surfaces and the proposed impervious surfaces for each station and Operations Center alternative. Existing impervious surface areas were estimated from aerial photographs. Anticipated impervious surfaces associated with each facility were estimated from conceptual station and Operations Center site plans. This process is discussed in more detail in Section 4.14.5.2, Surface Water Quantity.

Mitigation measures to offset potential impacts are also described and quantified for purposes of comparison. Water quantity impacts are typically mitigated with the use of a detention facility, which reduces impacts by slowing the rate of discharge from the site. Similar to the water quality analysis,

water quantity impacts are evaluated based on change in impervious surface; however, mitigation is evaluated based on the amount of impervious surface created by a project, regardless of existing conditions. Estimates of detention volumes were prepared per the guidance in Seattle's *Flow Control Technical Requirements Manual* using StormShedTM modeling software by Engenious Systems, Inc.

The Water section has been prepared based on review of statutory and regulatory requirements, regulatory guidance documents, existing data, and technical documents prepared for the analysis of this project listed below. Refer to Appendix HH, References, for a list of supporting documents used for the Water Impacts Analysis.

4.14.4 Affected Environment (Surface Water Quantity/Quality)

The Green Line proposes construction in a heavily urbanized and developed area with a high percentage of existing impervious surfaces. Analysis indicates that the Green Line should produce only a limited increase in impervious surfaces and a decrease in pollutant generating surfaces (by replacing existing pollutant generating surfaces with non-pollutant generating surfaces). The Green Line is not expected to produce discharges other than stormwater. Consequently, as explained later in this section, the change in stormwater runoff patterns resulting from the Green Line are not expected to significantly impact the environment.

Stormwater runoff from the project area drains to the following receiving water bodies: Lake Washington Ship Canal, Lake Union, Elliott Bay, Duwamish Waterway, Longfellow Creek, and Puget Sound. Of the listed receiving water bodies, all but Longfellow Creek are listed as "designated" receiving waters in the *Flow Control Technical Requirements Manual* (Seattle 2000). Designated receiving waters are defined as having the capacity to receive drainage discharges. General descriptions of each water body, including beneficial use classification and 303(d) listing, is provided so that the potential impacts from the proposed project may be better understood. Refer to Figures 4.14-1 through 4.14-5 of the Draft EIS for maps depicting receiving water bodies, drainage basins, combined sewer basins, and outfall locations.

Locations of Federal Emergency Management Agency (FEMA) floodplains relative to proposed station alternatives were checked. Longfellow Creek has the only floodplain near a proposed station site. The Longfellow Creek floodplain is discussed below in the West Seattle Segment.

4.14.4.1 Receiving Water Bodies

Lake Washington Ship Canal (Salmon Bay)

All alignment alternatives of the Green Line are proposed to cross the Lake Washington Ship Canal toward the west end of the canal in Salmon Bay near the Ballard Bridge. The Ship Canal transports water from Lake Union through the Hiram M. Chittenden navigation locks in Ballard.

Surface water quality in Salmon Bay is influenced by freshwater inflows from Lake Washington and combined sewage overflows (CSOs) and storm drains from the surrounding urbanized watershed, including the study area. The Ship Canal from the Ballard Locks to Lake Washington is classified as "Lake Class" in the WAC 173-201A130, having a special condition that salinity shall not exceed one part per thousand (1.0 ppt) at any point or depth along a line that transects the Ship Canal at the University Bridge. The Ship Canal is listed on the 1998 303(d) list for exceeding sediment bioassay criteria and for exceeding fish tissue criteria for dieldrin.

Floodplain

Salmon Bay's floodplain is effectively nonexistent since the water level is controlled at the Ballard Locks. The Ballard Locks maintain the water level in the Ship Canal within a 2-foot range between 20.0 and 22.0 feet (Corps of Engineers Datum). Salmon Bay's shores are completely lined by marinas, houseboat moorage, commercial docks and dry docks, and other water-dependent industry.

Ship Canal Sediments

The Ship Canal has sediment composed of silty sand with a sand/silt ratio that varies with specific location (Serdar et al. 2000). Elevated levels of various chemical constituents are present in sediments throughout the vicinity of the Ballard Crossing alternatives. Metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and tributyltin are present at highly variable, but elevated levels throughout this vicinity (Cubbage 1992; Serdar 1976; Serdar et al. 2000). Concentrations of chemicals in the sediment east of the Ballard Bridge tend to be lower than west of the bridge (Tables 4.14-1 and 4.14-2). Concentrations also tend to be lower at mid-channel locations than those closer to shore. Locations within the Fishermen's Terminal area tend to have the highest concentrations of contaminants, particularly areas closer to the southern shoreline.

Table 4.14-1. Sediments (mg/kg dw) at Sampling Sites Near the Alternative Ballard Crossing Locations for the Green Line

	Alternative 1.1.1 (West)		Alternative 1.1.2 (Far West)		Alternative 1.2 (East)	
	Southern Shore ^a	Northern Shore ^c	Northern Shore ^a	Mid- Channel ^b	Mid- Channel ^c	Southern Shore ^d
Arsenic	10–152	13	13–31	>20	13	6–10
Cadmium	ND–1.7	1.3	0.9–2.0	>0.5	1.6	>0.0–0.5
Chromium	37–96	77	110–121	49	56	40–54
Copper	210–10,800	327	536–570	92	210	48–130
Mercury	0.7–43	0.7	1.0–1.1	0.5	0.6	0.2–0.4
Nickel	38–61	64	94–102	46	54	42–60
Lead	100–1,310	150	187–220	82	114	12–65
Zinc	210–4,150	368	453–460	118	269	86–180
LPAH	0.1–78.3	16.9	0.1–0.6	1.6	14.1	0.1–2.2
HPAH	0.3–250.0	31.2	0.4–19.1	5.1	16.5	0.2–2.5
PCBs	ND–0.780	ND	ND–0.007	ND	ND	ND–0.001
Tributyltin (µg/kg dw)	0.170– 644.81	0.935	1.080–1.401		0.597	0.062–0.071

mg/kg dw = milligrams per kilogram (dry weight); ND= not detected.

^a Serdar (1996); Serdar et al. (2000).

^b Cubbage (1992).

^c Serdar et al. (2000).

^d Cubbage (1992); Serdar et al. (2000).

Table 4.14-2. Sediments (mg/kg dw) Measured in Sediment Samples From the Alternative Green Line Ballard Crossing Locations Adjacent to the Ballard Bridge

	West Side	East Side	EPA Limits for Hazardous Waste	WAC 173-303
Arsenic	U-30	U	5.0	5.0
Cadmium	U-0.9	U	1.0	1.0
Chromium	61-70	58-86	5.0	5.0
Copper	266-407	173-280	*	**
Mercury	0.7-0.8	0.5-0.7	0.2	0.2
Lead	127-284	92-156	5.0	5.0
Zinc	U	U	*	**
LPAH	17.4-34.7	47.4-64.8	*	combined total of 10,000
HPAH	77.5-227.9	125.3-205.5	*	
PCBs	0.9-2.3	0.8-2.6	50	2-50
Tributyltin	0.3E-1.0	0.05-0.18E	*	**

(Parametrix June, 2003)

mg/kg = milligrams per kilogram; U = Undetected; E = Estimated

* Regulatory values not established.

** Regulatory values not established; however, they may be regulated based on toxicity testing (i.e., bioassay).

Lake Union

Lake Union receives runoff from the Downtown Segment of the Green Line through combined sewer overflows (CSOs). Lake Union is located in a highly urbanized watershed. The Ship Canal and Lake Union represent a transitional area between the fresh waters of Lake Washington and marine waters of Puget Sound.

Surface water quality is influenced by freshwater inflows from Lake Washington via the Ship Canal, and from storm drains and CSOs. At depth, water quality is influenced by saline water introduced through the navigation locks. During the summer (primarily July, August, and September), a layer of very low dissolved oxygen (~1 mg/l) saline water forms along the bottom of Lake Union (Hansen et al. 1994). Saline water and water temperature influence strong stratification of the water column that inhibits mixing of the surface and bottom waters during summer months (CH2M Hill 1999). Consumption of oxygen in the bottom waters is caused by the decay and oxidation of primarily organic matter on the lake bottom (biochemical oxygen demand), an effect that is common to lakes but which results in oxygen depletion in shallow lakes that stratify. The anoxic bottom layer in Lake Union typically breaks up rapidly, along with the thermocline in Lake Union, during fall.

Ecology has listed Lake Union on the 1998 303(d) list for exceeding sediment bioassay criteria and fish tissue criteria for dieldrin (see Section 4.15, Plants and Animals).

Elliott Bay

Elliott Bay receives runoff from the Interbay, Seattle Center, Downtown, SODO, and West Seattle Segments of the alignment alternatives being studied for the Green Line. Stormwater from the area of the Green Line alternative alignments is discharged into Elliott Bay via the Duwamish and storm drains and CSOs. Elliott Bay, part of Puget Sound, is a tidal water body with heavily industrialized shores and a major shipping center. It also supports a variety of fish, bird, mammal, and plant species and is an important salmonid migratory route.

Elliott Bay is considered a Class A (excellent quality) marine water body. Ecology placed Elliott Bay on the 1998 303(d) list for exceeding water quality criteria for fecal coliform and sediment quality criteria.

Duwamish River

The West Seattle Segment of the Green Line would cross the East and West Waterways of the Duwamish River atop the West Seattle Bridge, or alternatively, via a new bridge that would be constructed adjacent to the existing bridge. The Duwamish River receives stormwater from CSOs and storm drains from the study area.

The Duwamish River, a tidally influenced water body, discharges into Elliott Bay, creating the Duwamish Estuary. Ecology has classified the Duwamish as a Class B (good quality) river from its mouth to the confluence with the Black River (WAC 173-201A-130). Ecology has placed the Duwamish River on the 1998 303(d) list for exceeding water quality criteria for dissolved oxygen, pH, fecal coliform, and sediment quality criteria.

Longfellow Creek

Several alignment alternatives studied for the Green Line would cross Longfellow Creek south of the Nucor Steel plant. Longfellow Creek drains approximately 2,685 acres of the Delridge and Westwood neighborhoods in West Seattle. The stream originates in Roxhill Park and flows north for approximately 4.2 miles down the heavily urbanized Delridge corridor, through the industrial area below the West Seattle Bridge, and finally discharges into the West Duwamish Waterway (King County 2000). The Preferred Alternative presented in this Final EIS (Alternative 6.3(s)) would not affect the open channel of Longfellow Creek, because of the guideway and Delridge 3 station location north of Nucor Steel.

Because the Longfellow Creek basin has been developed, it is assumed that the hydrology of the stream is similar to other similarly sized urban streams in Puget Sound lowland basins (Booth 1989; Booth and Jackson 1997). Urbanization can result in significant impacts, either directly or indirectly, to the watershed ecosystem. Direct impacts result from the physical alteration of stream channels and shoreline areas through the installation of bulkheads or culverts, and increased stream channelization (straightening). Changes in land use patterns can lead to indirect impacts such as altering the hydraulic flow regimes and water quality conditions. The altered flow regimes typically result in decreased base flows, increased magnitude and frequency of flood flows, and more rapid changes in stream flows. These changes often increase streambed scour, bank erosion, and sedimentation, further affecting the instream habitat. Urbanization in the Puget Sound lowland area has produced a shift in hydrologic regimes, from a groundwater dominated system to a stormwater runoff driven system (May 1996). Urban runoff increases the nutrient and pollutant input to area streams, thereby affecting the water quality and the aquatic ecosystem. Changes in water quality and aquatic habitat can affect the abundance and species diversity of the biotic communities within the watershed.

Approximately one third of the creek length is contained in closed pipes. In the project area, the creek flows through the West Seattle Golf Course in an open channel. It flows under SW Genesee Street in a culvert and then reverts to an open channel until it reaches SW Andover Street, where it enters a 60-inch pipe (Longfellow Creek Watershed Management Committee 1992). The creek remains in the 3,161-foot-long pipe to its discharge point. With Alternative 6.1, the Green Line guideway would cross the open channel just south of SW Andover Street near 26th Avenue SW. With Alternatives 6.2, 6.4, or 6.4(s) the guideway would be located above SW Andover Street where Longfellow Creek is contained in a pipe. Alternatives 6.3(s) or 6.5 would also cross sections of Longfellow Creek where it is contained in a pipe or culvert under SW Spokane Street and SW Genesee Street, respectively. Any of the Delridge station alternatives associated with those alignment alternatives would be located on the east side of the creek. The creek would receive stormwater runoff from the Green Line downstream of the SW Andover Street

pipe entrance through City storm drains. Longfellow Creek is designated as a Class A (excellent quality) stream. Ecology included Longfellow Creek on the 303(d) list of threatened or impaired water bodies in 1998 because it exceeded fecal coliform criteria for Class A fresh water bodies.

Floodplain

FEMA has mapped the 100-year floodplain for Longfellow Creek (Figure 4.14-1). The specific 100-year flood elevation was not provided on the FEMA map of Longfellow Creek.

Puget Sound

Puget Sound receives runoff from the West Seattle Segment of the Green Line. It also receives treated runoff from portions of the alignment with combined or partially separated sewers. Puget Sound is designated as a Class AA (Exceptional) marine water body. Ecology has listed South-Central Puget Sound and the East Passage of Puget Sound on the 1998 303(d) list for exceeding ammonia-N, pH, and fecal coliform criteria for marine water.

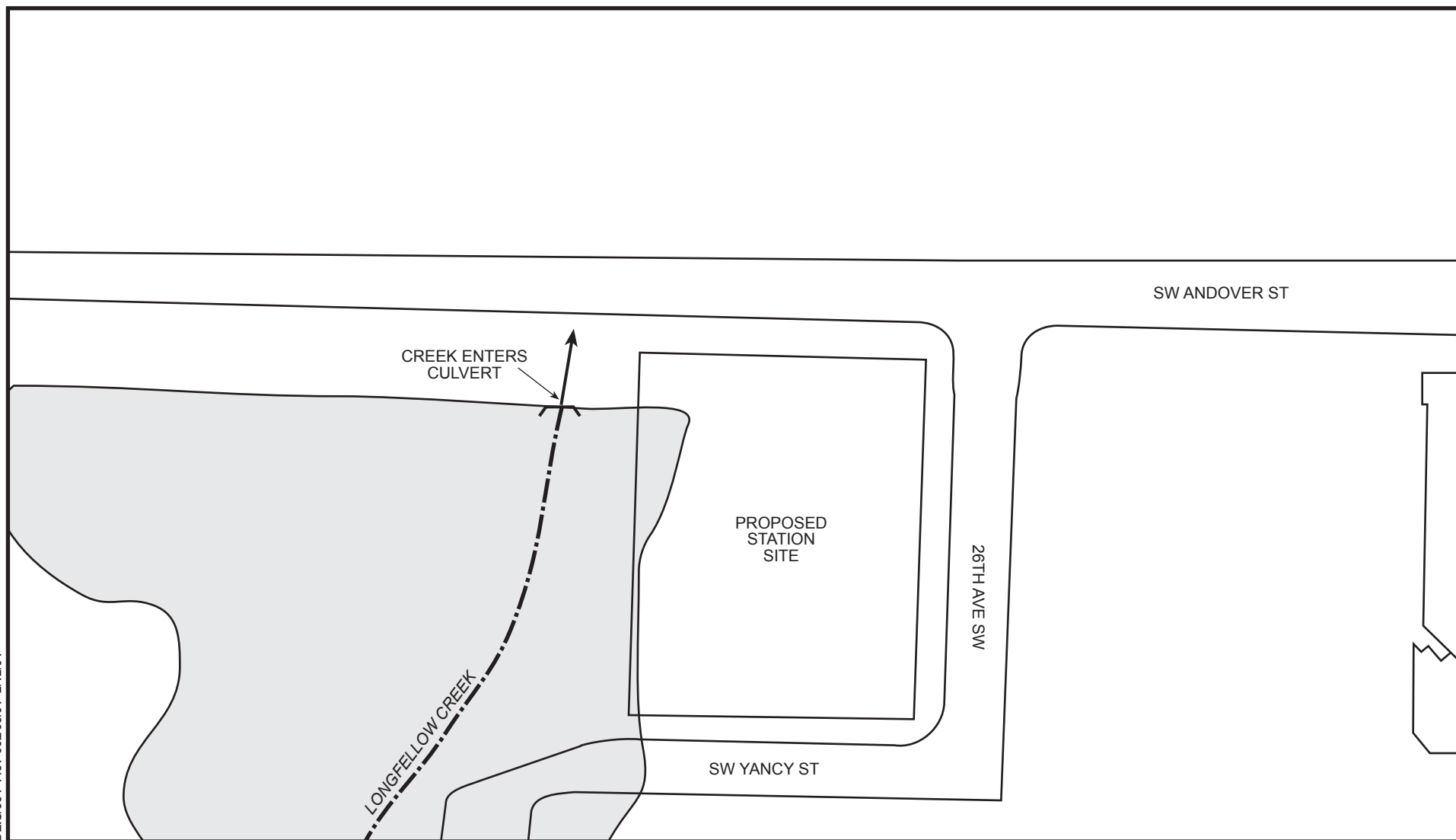
4.14.4.2 Seattle Drainage System

Stormwater reaches the receiving waters described above through a complex drainage system consisting of three different types of systems: combined sewer, partially separated sewer, and completely separated sewer systems. Each of the three systems is described below.

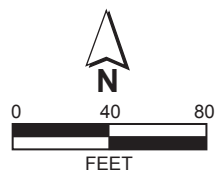
- **Combined Sewer System.** Seattle's drainage system was originally constructed as a Combined Sewer System, in which a single pipe conveys both sewage and stormwater. During normal operation, all of the combined effluent flows to a wastewater treatment plant before being discharged into a receiving water body. During heavy rainfall events, however, discharges of untreated sewage and stormwater are released to local water bodies through combined sewage overflows (CSOs).
- **Partial Separation System.** In the late 1960s, an effort to reduce the amount of CSO into local water bodies began. The new system collected street runoff into separate pipes, but left building downspout hookups connected to the combined sewer. This system is called partial separation. Approximately one-third of the City's combined sewer system has been converted into a partially separated system. Downspouts from newly constructed buildings within these areas are now connected to the storm system wherever possible.
- **Completely Separated System.** In other areas of the City, the storm system and sanitary sewer systems have been completely separated. The sewage is routed to a treatment plant and the stormwater is discharged to a receiving water body.

The City of Seattle developed a CSO Reduction Plan in 1998 (updated in 2001) to reduce CSOs to an average of no more than one uncontrolled discharge per year per CSO outfall. As of 2000, Seattle has installed monitoring devices on all CSO outfalls. In addition to separating combined sewers, other methods of reducing CSOs include construction of combined sewer storage facilities, increasing sewer capacity, and requiring on-site stormwater flow controls.

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SEATTLE MONORAIL PROJECT



Zone A - Areas of 100-year Flood

Figure 4.14-1
FEMA Flood Hazard Area
Delridge 2 (Andover)

4.14.4.3 Surface Water Quality

Operational Impacts

Roadway and urban area stormwater runoff potentially contains numerous contaminants: oil and grease; heavy metals such as copper, lead, and zinc; nutrients such as nitrates and phosphates; pesticides; herbicides; and sediments. Most of these contaminants are associated with increases in impervious surfaces (e.g., pavement and buildings) and the use of motor vehicles. Impervious surfaces promote the storage and wash-off of pollutants from automobile emissions and other sources. Motor vehicles are the primary source of water quality degradation, producing oils and grease, metals, and combustion byproducts. Landscaped areas, another important source of pollutants from developed sites, can contribute fertilizer and pesticide residues, such as phosphates and nitrates, to stormwater runoff. (See Appendix T of the Draft EIS, Stormwater Pollutants in Urban Runoff and Potential Adverse Impacts for additional information.) The *Stormwater Treatment Technical Requirements Manual* (Seattle 2000) defines pollution generating and non-pollution generating surfaces in the following manner:

- **Pollution Generating Impervious Surfaces (PGIS)** include road surfaces accessible by vehicle, uncovered driveways and parking lots, and roofs made with uncoated metal products.
- **Pollution Generating Pervious Surfaces (PGPS)** include vegetated areas or exposed soil subject to use of pesticides and fertilizers, such as landscaped areas and lawns (unless an effective pesticide and fertilizer management plan is implemented).
- **Non-Pollution Generating Impervious Surfaces** include buildings constructed with non-pollution generating roof materials, covered parking and driveways, and impervious surfaces not accessible to vehicles (and not hydraulically connected to PGIS).

Runoff carrying pollutants from Green Line station sites located within a combined sewer system would not be expected to have a significant adverse impact on receiving water bodies unless the runoff causes an increase in stormwater volumes beyond pipe capacity, because stormwater would be treated at the West Point Treatment Plant prior to being discharged to Puget Sound. Only during combined sewer system overflow conditions could untreated stormwater enter the receiving waters. Refer to Tables 4.14-3 through 4.14-8 for a list of station location alternatives located in combined sewer areas.

Increased impervious surface area to station sites located in combined sewer areas, if unmitigated (i.e., without detention), could increase the frequency and duration of stormwater discharges into the combined system. The effect could be to increase the frequency and duration of combined sewer overflow events. Discharge from CSOs can contribute to fecal coliform levels of receiving waters, as well as a range of other contaminants potentially found in raw sewage. However, the frequency and duration of stormwater discharge to combined sewers would not change because either the amount of impervious surface would not change or mitigation (detention) would be provided.

If unmitigated, station and Operations Center sites located in partially separated and completely separated sewer areas could have an impact on the water quality of receiving water bodies because runoff carrying a range of pollutants from the parking areas could be conveyed directly to the receiving water. The impact would be expected to be minor given the small portions of the sites accessible to vehicular traffic, and the size of the Ship Canal, Lake Union, Elliott Bay, the Duwamish, and Puget Sound. Potential water quality mitigation is discussed below.

An NPDES permit would be required for stormwater discharges to surface water that are associated with industrial activities, which could occur at the Operations Center; however, the permit would not regulate

non-industrial activities associated with the stations, such as employee parking, loading/unloading areas, roofs, landscaping, or sidewalks.

Impacts from Alignment and Station Location Alternatives

Potential impacts to surface water quality from each component of the Green Line are discussed in this section. Sources of pollution could result from the stations sites, associated off-site pick-up and drop-off areas and bus layover zones, the Operations Center, guideways, and traction power substations.

Station Sites

Potential station sites being analyzed (assumed to be 100 percent impervious) could contain a mixture of pollution and non-pollution generating impervious surfaces. A number of station sites could provide several on-site parking spaces for technical and security staff and associated driveway for accessing the spaces. A few stations could provide on-site bus layover/parking. In order to obtain conservative (higher) estimates of pollution generating areas, vehicle and bus parking areas were assumed to be uncovered.

The concentration of pollutants contained in site runoff, and their impact on receiving water bodies, varies considerably depending on many factors, including the average daily vehicle trips to the site and sensitivity of the receiving water body. Use of parking for technical and security staff is assumed to be relatively low, with approximately 12 trips per day expected. However, unmitigated discharges of stormwater from areas accessible to vehicles could contain low contaminant concentrations. Expected contaminant loading rates resulting from each of the alternatives would depend on whether or not employee or other parking is provided, and the size of the bus layover/parking area if provided.

Existing PGIS was estimated for each site using digital ortho-rectified aerial photographs (Walker 2003). New PGIS was estimated using conceptual station layouts. The difference between the two can be used to compare unmitigated potential impacts to the affected environment for station alternatives. This analysis assumes that the existing and proposed land use would have similar pollutant generating characteristics. For this project, most of the existing PGIS is parking lots or loading areas, which would have similar characteristics to the proposed station parking lots. Areas are summarized in Tables 4.14-3 through 4.14-9.

Non-PGIS areas include station buildings and guideway overhangs, bicycle storage areas, and remaining site area not accessible to vehicles. The station buildings and guideway overhangs would be constructed with non-pollution generating roof material. The remaining site area would not be subject to vehicular traffic or any industrial activities. Therefore, runoff from the roof and site area (excluding parking and bus layover) is not expected to impact the water quality of the receiving water bodies.

The pollution generating impervious surface (PGIS) that would result from replacing existing improvements with station sites or an Operations Center is summarized below for each segment. Some of the Green Line route alternatives also contain multiple station alternatives. When totaling the PGIS table columns, the more conservative of the station alternatives is added into the total. The figures included in the total are bolded.

Segment 1: Ballard Segment

Alternatives

All of the station location alternatives in the Ballard Segment currently contain pollution generating impervious surfaces. All station location alternatives (except NW Market 1, 2, and 3A) would only add

approximately 1,900 square feet of PGIS for employee parking, resulting in a decrease of PGIS. The NW Market 1 (Southwest), NW Market 2 (Center), and NW Market 3A alternatives would be located at the same site. The NW Market 1 (Southwest) and NW Market 2 (Center) alternatives both propose a potential on-site bus layover zone that accounts for the majority of the PGIS added. Both the NW Market 1 and 2 alternatives result in an increase in PGIS. If unmitigated, either of these alternatives could result in a lower quality of runoff leaving the site. However, runoff from the site would be mitigated as described in the following mitigation section. NW Market 3A includes a staging area that would be used during the construction of the Green Line. The staging area accounts for all of the PGIS proposed for the site. The construction staging area would be mitigated as described in Section 4.17 to minimize impacts to water quality during the construction of the project. Overall, Alternative 1.1 or 1.1(s) could result in a maximum increase in PGIS of approximately 3 percent and Alternative 1.2 would result in a small decrease in PGIS as shown in Table 4.14-3.

Table 4.14-3. Ballard Segment – Pollution Generating Impervious Surface

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 1.1 or 1.1(s) - West Side of 15th					
Crown Hill 1 (West, 85 th)	7,000	1,900	-5,100	-73%	Combined
Crown Hill 1A (West 85 th)	4,700	1,900	-2,800	-60%	Combined
NW 65 th 1 (West)	5,800	1,900	-3,900	-67%	Combined
NW 65 th 1A (West)	5,800	1,900	-3,900	-67%	Combined
NW 65 th 1B (West)	5,800	1,900	-3,900	-67%	Combined
NW Market 1 (Southwest)	20,300	28,000	+7,700	+38%	Partially Separated
NW Market 3 (Northwest)	9,300	1,900	-7,400	-80%	Partially Separated
NW Market 3A (Northwest)	39,300	41,900	+2,600	+7%	Partially Separated
TOTAL	30,800	31,800	+1,000	3%	—
Alternative 1.2 – Center of 15th					
Crown Hill 2 (Center)	8,400	1,900	-6,500	-77%	Combined
NW 65 th 2 (Center)	2,600	1,900	-700	-27%	Combined
NW Market 2 (Center)	22,200	27,000	+4,800	+22%	Partially Separated
TOTAL	33,200	30,800	-2,400	-7%	—

Note: sf = square feet.

Only bolded numbers are included in total, as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-3a below. NW Market 3A is the only station that would increase PGIS over existing amounts. A portion of this site would be used as a construction staging area and would be mitigated as described above in the Alternatives section. The Preferred Alternative would reduce overall

PGIS from existing site conditions by approximately 4,100 square feet, whereas Alternatives 1.1 would increase PGIS by a maximum of 1,000 square feet, and Alternative 1.2 would reduce PGIS by at least 2,400 square feet.

Table 4.14-3a. Ballard Segment Preferred Alternative– Pollution Generating Impervious Surface

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Crown Hill 1A	4,700	1,900	-2,800	-60%	Combined
NW 65 th 1B (West)	5,800	1,900	-3,900	-67%	Combined
NW Market 3A (Northwest)	39,300	41,900	+2,600	+7%	Partially Separated
TOTAL	49,800	45,700	-4,100	-8%	—

Note: sf = square feet.

Segment 2: Interbay/Magnolia Segment

Alternatives

The majority of the station alternatives within the Interbay/Magnolia Segment, with the exception of the Howe 1 (West), Howe 2 (Center), and Dravus 1B alternatives, currently have high percentages of PGIS on the site. Replacing the existing land use with monorail stations for all station alternatives, except Howe 1 or 2, is anticipated to result in no change or a reduction of pollution generating surface and therefore an improvement in the quality of runoff leaving the site. Station alternatives Howe 1 or 2, if unmitigated, may decrease the quality of stormwater leaving the site, and consequently could have a detrimental effect on the receiving water. Overall, both alternatives would result in the reduction of PGIS. Alternative 2.2 would result in a greater percentage of PGIS reduction as shown in Table 4.14-4.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-4a below. The two stations included in the Preferred Alternative would reduce the amount of PGIS from existing conditions and therefore, would not have an adverse effect on the receiving water. The Preferred Alternative would result in a greater decrease in existing PGIS than the other alternatives. The Preferred Alternative would reduce PGIS by 22,400 square feet, whereas Alternative 2.1 and 2.2 would reduce PGIS by a minimum of 4,600 and 20,900 square feet, respectively.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Alternatives

Within the Queen Anne/Seattle Center/Belltown Segment, the station location alternatives add either no PGIS, or approximately 1,900 square feet for technical staff and security parking. All of the station alternatives, except for Seattle Center/Queen Anne 2 (South), are located in combined sewer areas. The Seattle Center/Queen Anne 2 (South) alternative is located in a partially separated area, but appears to flow into a combined system east of the Seattle Center. Overall, any of the alignment alternatives would decrease PGIS over existing conditions; however, Alternative 3.3 would remove the most PGIS, as shown in Table 4.14-5.

Table 4.14-4. Interbay/Magnolia Segment – Pollution Generating Impervious Surface

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 2.1 or 2.1(s) - West Side of 15th/Center of Elliott					
Dravus 1 (16 th)	23,700	6,100	-17,600	-74%	Combined
Dravus 1A (16 th)	22,100	13,900	-8,200	-37%	Combined
Dravus 1B (Barrett)	0	0	0	No Change	Combined
Howe 1(West)	0	1,900	+1,900	N/A	Partially Separated
Future – Howe 1A (Blaine)	15,900	0	-15,900	-100%	Partially Separated
Elliott & Mercer 1 (Center)	10,200	1,900	-8,300	-81%	Combined
Elliott & Mercer 1A (Center)	8,400	1,900	-6,500	-77%	Combined
TOTAL	8,400	3,800	-4,600	-55%	—
Alternative 2.2 – Center of 15th/West Side of Elliott					
Dravus 2 (15 th)	8,500	1,900	-6,600	-78%	Combined
Howe 2 (Center)	0	1,900	+1,900	N/A	Partially Separated
Prospect 3 (West)	18,800	11,400	-7,400	-39%	Combined
Elliott and Mercer 2 (West)	18,100	1,900	-16,200	-90%	Combined
TOTAL	26,600	5,700	-20,900	-79%	—

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

N/A =Calculation not possible – requires division by zero.

Table 4.14-4a. Interbay/Magnolia Segment Preferred Alternative – Pollution Generating Impervious Surface

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Dravus 1B (Barrett)	0	0	0	No Change	Combined
Future – Howe 1A (Blaine)	15,900	0	-15,900	-100%	Partially Separated
Elliott & Mercer 1A (Center)	8,400	1,900	-6,500	-77%	Combined
TOTAL	24,300	1,900	-22,400	-92%	—

Note: sf = square feet.

**Table 4.14-5. Queen Anne/Seattle Center/Belltown Segment –
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 3.1 – Seattle Center/Republican					
Seattle Center/Queen Anne 1 (North)	0	0	0	No change	Combined
Seattle Center/Queen Anne 1A (North)	0	0	0	No change	Combined
Seattle Center/Fifth & Broad 1	23,800	1,900	-21,900	-92%	Combined
Seattle Center/Fifth & Broad 1A	20,600	1,900	-18,700	-91%	Combined
Belltown 1 (Center-West)	0	0	0	No change	Combined
Belltown 1A (Center-West)	0	0	0	No change	Combined
Belltown 2 (Center-East)	12,900	0	-12,900	-100%	Combined
TOTAL	20,600	1,900	-18,700	-91%	—
Alternative 3.2 – Mercer					
Seattle Center/Queen Anne 1 (North)	0	0	0	No change	Combined
Seattle Center/Queen Anne 1A (North)	0	0	0	No change	Combined
Seattle Center/Fifth & Broad 1A	20,600	1,900	-18,700	-91%	Combined
Seattle Center/Fifth & Broad 2 (Harrison)	23,700	1,900	-21,800	-92%	Combined
Belltown 1 (Center-West)	0	0	0	No change	Combined
Belltown 1A (Center-West)	0	0	0	No change	Combined
Belltown 3 (West)	4,000	0	-4,000	-100%	Combined
TOTAL	20,600	1,900	-18,700	-91%	—
Alternative 3.3 – Thomas					
Seattle Center/Queen Anne 2 (South)	23,800	0	-23,800	-100%	Partially Separated
Seattle Center/Fifth & Broad 1	23,800	1,900	-21,900	-92%	Combined
Seattle Center/Fifth & Broad 1A	20,600	1,900	-18,700	-91%	Combined
Belltown 1 (Center-West)	0	0	0	No change	Combined
Belltown 1A (Center-West)	0	0	0	No change	Combined
Belltown 2 (Center-East)	12,900	0	-12,900	-100%	Combined
TOTAL	44,400	1,900	-42,500	-96%	—
Alternative 3.5 – Second/Denny					
Seattle Center/Queen Anne 2 (South)	23,800	0	-23,800	-100%	Partially Separated
Denny 3	8,200	1,900	-6,300	-77%	Combined
Belltown 1 (Center-West)	0	0	0	No change	Combined

**Table 4.14-5. Queen Anne/Seattle Center/Belltown Segment –
Pollution Generating Impervious Surface (continued)**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Belltown 1A (Center-West)	0	0	0	No change	Combined
Belltown 2 (Center-East)	12,900	0	-12,900	-100%	Combined
TOTAL	32,000	1,900	-30,100	-94%	—

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-5a below. None of the three stations would increase the amount of PGIS over existing conditions and, therefore, would not have an adverse effect on the receiving water. The Preferred Alternative as well as Alternative 3.1 and 3.2 would each reduce existing PGIS by a minimum of 18,700 square feet depending on the station alternatives selected. Alternatives 3.3 and 3.5 would result in larger reductions 42,500 and 30,100 respectively.

**Table 4.14-5a. Queen Anne/Seattle Center/Belltown Segment Preferred Alternative –
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Seattle Center/Queen Anne 1A (North)	0	0	0	No change	Combined
Seattle Center/Fifth & Broad 1A	20,600	1,900	-18,700	-91%	Combined
Belltown 1A (Center-West)	0	0	0	No change	Combined
TOTAL	20,600	1,900	-18,700	-91%	—

Note: sf = square feet.

Segment 4: Downtown/Pioneer Square Segment

Alternatives

Within the Downtown/Pioneer Square Segment, only two of the station alternatives would add approximately 1,400 square feet of PGIS to existing sites for technical staff and security parking. All four of the alignment alternatives would result in a decrease in PGIS, with Alternatives 4.1, 4.2, 4.3, and 4.4 resulting in removal of 100 percent of the existing PGIS on the station sites. For stations that currently contain PGIS, this would result in an improvement in the quality of runoff leaving those sites. For sites that currently do not contain PGIS, no change in quality of runoff leaving the sites would be expected. Alternative 4.2 would remove the greatest amount of PGIS from the sites, as shown in Table 4.14-6.

**Table 4.14-6. Downtown/Pioneer Square Segment –
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 4.1 - West Side of Second					
Fifth & Stewart 1 (Northwest)	12,200	0	-12,200	-100%	Combined
Fifth & Stewart 1A (West)	13,800	0	-13,800	-100%	Combined
Fifth & Stewart 2 (Virginia)	0	0	0	No change	Combined
Fifth & Stewart 2A (Virginia Center)	0	0	0	No change	Combined
Pike 1 (West) A	21,900	0	-21,900	-100%	Combined
Pike 1 (West) B	21,900	0	-21,900	-100%	Combined
Madison 1 (West)	0	0	0	No change	Combined
Yesler 1 (West)	19,800	0	-19,800	-100%	Combined
TOTAL	41,700	0	-41,700	-100%	—
Alternative 4.2 – East Side of Second with Crossover					
Fifth & Stewart 3 (Lenora)	16,000	0	-16,000	-100%	Combined
Pike 2 (East)	12,200	0	-12,200	-100%	Combined
Madison 2 (East)	0	0	0	No change	Combined
Yesler 1 (West)	19,800	0	-19,800	-100%	Combined
TOTAL	48,000	0	-48,000	-100%	—
Alternative 4.3 - Center of Second					
Fifth & Stewart 2 (Virginia)	0	0	0	No change	Combined
Fifth & Stewart 3 (Lenora)	16,000	0	-16,000	-100%	Combined
Pike 3 (Center)	8,400	0	-8,400	-100%	Combined
Madison 3 (Center)	0	0	0	No change	Combined
Yesler 2 (Center)	19,800	0	-19,800	-100%	Combined
TOTAL	28,200	0	-28,200	-100%	—
Alternative 4.4 East Center of Second					
Fifth & Stewart 3 (Lenora)	16,000	0	-16,000	-100%	Combined
Pike 2A (East Center)	12,200	1,400	-10,800	-89%	Combined
Madison 2A (East Center)	0	1,400	+1,400	N/A	Combined
Yesler 1 (West)	19,800	0	-19,800	-100%	Combined
TOTAL	48,000	2,800	-45,200	-94%	-

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-6a below. None of the four stations would create any new or replaced PGIS on the sites. Therefore, they would not have an adverse impact on the receiving water. The Preferred Alternative and Alternative 4.1 would each reduce PGIS from existing site conditions by approximately 41,700 square feet. Other Alternatives would result in similar reductions: Alternative 4.2 48,000 square feet, Alternative 4.3 28,000 square feet, and Alternative 4.4 45,200 square feet.

**Table 4.14-6a. Downtown/Pioneer Square Segment Preferred Alternative –
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Fifth & Stewart 2A (Virginia Center)	0	0	0	No change	Combined
Pike 1 (West) B	21,900	0	-21,900	-100%	Combined
Madison 1 (West)	0	0	0	No change	Combined
Yesler 1 (West)	19,800	0	-19,800	-100%	Combined
TOTAL	41,700	0	-41,700	-100%	—

Note: sf = square feet.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Alternatives

Due to the amount of PGIS that currently exists on the proposed station sites within the SODO/Chinatown International District/Pioneer Square Segment, only the Lander 1 alternative would result in an increased amount of PGIS. The Lander 1 site is located in a partially separated area, and if unmitigated, could have an adverse effect on the quality of runoff entering Elliott Bay. All remaining station alternatives would result in a reduction of PGIS and would improve the quality of runoff leaving the sites over existing conditions. Overall, both alignment alternatives would reduce the total amount of PGIS on the proposed station sites with Alternative 5.1 resulting in the greatest decrease (Table 4.14-7).

**Table 4.14-7. SODO/Chinatown ID/Pioneer Square Segment –
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 5.1 - East Side of Third/Utah					
Weller/King Street 1 (Standard)	51,000	0	-51,000	-100%	Combined
Safeco Field 1	100,800	0	-100,800	-100%	Combined
Lander 1 (Northeast)	700	6,000	+5,300	+757%	Partially Separated
Lander 2 (Southwest)	35,600	10,300	-25,300	-71%	Partially Separated

**Table 4.14-7. SODO/Chinatown ID/Pioneer Square Segment –
Pollution Generating Impervious Surface (continued)**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Lander 4 (Utah)	72,000	1,900	-70,100	-97%	Completely Separated
TOTAL	152,500	6,000	-146,500	-96%	—
Alternative 5.2 - West Side of Third/Utah (or 5.2(s) with addition of Safeco Station)					
Weller/King Street 2 (Event)	59,600	0	-59,600	-100%	Combined
Safeco Field 1	100,800	0	-100,800	-100%	Combined
Lander 3 (Diagonal)	14,900	8,000	-6,900	-46%	Partially Separated
TOTAL	175,300	8,000	-167,300	-95%	—

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-7a below. None of the three stations would increase the amount of PGIS over existing conditions and, therefore, would not have an adverse impact on the receiving water. The Preferred Alternative and Alternative 5.2 would each reduce PGIS from existing site conditions by approximately 167,300 square feet. Alternative 5.1 would result in a minimum reduction of 146,500 square feet.

**Table 4.14-7a. SODO/Chinatown ID/Pioneer Square Segment Preferred Alternative– Pollution
Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Weller/King Street 2 (Event)	59,600	0	-59,600	-100%	Combined
Safeco Field 1	100,800	0	-100,800	-100%	Combined
Lander 3 (Diagonal)	14,900	8,000	-6,900	-46%	Partially Separated
TOTAL	175,300	8,000	-167,300	-95%	—

Note: sf = square feet.

Segment 6: West Seattle Segment

Alternatives

All station alternatives within the West Seattle Segment would reduce PGIS over existing conditions, with the exception of Delridge 1A. Therefore, no adverse impact would be expected from any of the station alternatives except for Delridge 1A. Runoff from Delridge 1A could have a slight negative impact on receiving water if the redeveloped site did not incorporate water quality mitigation. However, runoff from the site would receive water quality treatment prior to release into the storm system. Alternative 6.1 would result in the greatest reduction of PGIS area, as shown in Table 4.14-8.

Table 4.14-8. West Seattle Segment – Pollution Generating Impervious Surface

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Alternative 6.1 - West Seattle I					
Delridge 1 (26 th)	36,300	32,000	-4,300	-12%	Partially Separated
Avalon 1 (Center)	22,300	1,900	-20,400	-91%	Combined
Alaska Junction 1 (42 nd /Edmunds)	19,800	1,900	-17,900	-90%	Combined
Alaska Junction 1A (42 nd /Edmunds)	19,800	1,900	-17,900	-90%	Combined
Morgan Junction 1 (West)	10,000	1,900	-8,100	-81%	Partially Separated
Morgan Junction 1A (West)	11,200	1,900	-9,300	-83%	Partially Separated
TOTAL	88,400	37,700	-50,700	-57%	—
Alternative 6.2 – West Seattle II					
Delridge 2 (Andover)	21,600	5,100	-16,500	-76%	Partially Separated
Avalon 2A (35 th)	14,900	0	-14,900	-100%	Combined
Avalon 2B (35 th)	1,000	0	-1,000	-100%	Combined
Alaska Junction 2 (44 th /California)	17,200	1,900	-15,300	-89%	Partially Separated
Morgan Junction 2 (Center)	14,000	1,900	-12,100	-86%	Partially Separated
TOTAL	53,800	8,900	-44,900	-83%	—
Alternative 6.3(s) Delridge North Subsegment					
Delridge 3 (Nucor)	20,000	0	-20,000	-100%	Partially Separated
Alternative 6.4 Andover/Yancy Subsegment					
Delridge 1A (26 th)	36,300	38,100	+1,800	+5%	Partially Separated
Alternative 6.4(s) Andover/Yancy Subsegment single beam					
No Station	N/A	N/A	N/A	No Change	Partially Separated
Alternative 6.5 Genesee Subsegment					
Delridge 4 (Genesee)	5,200 ¹	0	-5,200	-100%	Partially Separated

1 PGIS estimated from partial aerial photo.

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Impacts)

Pollution Generating Impervious Surfaces for stations included in the Preferred Alternative are summarized in Table 4.14-8a below. All of the stations selected would decrease PGIS from existing conditions, and therefore, would not have an adverse impact on the receiving water. The Preferred Alternative would reduce PGIS from existing site conditions by 48,200 square feet. Alternatives 6.1 and 6.2 would have similar reductions of approximately 50,700 and 44,900 square feet, respectively depending on the station alternatives selected.

**Table 4.14-8a. West Seattle Segment Preferred Alternative–
Pollution Generating Impervious Surface**

Station	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Delridge 3 (Nucor)	20,000	0	-20,000	-100%	Partially Separated
Avalon 2B (35 th)	1,000	0	-1,000	-100%	Combined
Alaska Junction 1 (42 nd /Edmunds)	19,800	1,900	-17,900	-90%	Combined
Morgan Junction 1A (West)	11,200	1,900	-9,300	-83%	Partially Separated
TOTAL	52,000	3,800	-48,200	-93%	—

Note: sf = square feet.

Parking Lot Runoff

The change in PGIS from existing conditions to post-project conditions is a useful tool to compare relative amounts of pollution that could be generated between the station and Operations Center alternatives. However, this analysis does not actually quantify the impacts to receiving waters in terms of actual concentrations of specific pollutants. Typical pollutant concentrations of parking lot runoff were used to link PGIS that would likely result from operation of station and Operations Center sites (non-industrial portion) to quantities of pollutants that could enter receiving water bodies.

Several studies have been done to measure typical amounts of pollutants found in runoff from parking lot runoff (Table 4.14-9). The same pollutants measured in these studies could be expected to occur on any parking lots proposed for the Green Line similar to the range of concentrations presented in this table.

Table 4.14-9. Studies of Pollutant Concentrations from Parking Lot Runoff

Pollutant	University of Washington Study ^a Year 1 (1996) (mean)	University of Washington Study ^b Year 6 (2002) (mean)	Heritage Marketplace Field Evaluation Clark County, WA ^c (2002) (1 storm)	Sea-Tac (NEPL) ^d Year 1 (1999) (mean)	Paved Parking Lot Conditions, City of Long Beach, CA ^e (2001) (mean)	Park and Ride Lot Runoff Data ^f Caltrans (1998-2001) (mean)
Oil and Grease (mg/L)	--	0.164	ND	--	--	--
TSS (mg/L)	--	--	206	7.4	36	61.8
TPH (mg/L)	--	--	--	0.43	--	--
Cu (µg/L)	9	8.0	30	4.7	28	16.7
Pb (µg/L)	0.2	--	10	<2.0	45	9.2
Zn (µg/L)	12	21.6	240	78	293	158.8

Pollutant Abbreviations: TSS = Total suspended solids; TPH = Total Petroleum Hydrocarbons; Cu = Copper; Pb = Lead; Zn = Zinc

--" Indicates no data available, reported, or applicable.

^a Stormwater data from one asphalt parking stall. Renton, WA, Year 1 (Booth, Derek B., Jennifer Leavitt, and Kim Peterson 1999).

^b Stormwater data from one asphalt parking stall. Renton, WA, Year 6 (Brattebo, Ben and Booth, Derek, Draft September 2002).

^c Stormwater data from combined parking lot and roof runoff. (Stormwater Management Inc., Research and Development 2002).

^d Sea-Tac North Employees' Parking Lot (Parametrix, Inc. 1999).

^e Characteristics of Parking Lot Runoff Produced by Simulated Rainfall (Tiefenthaler, Liesl L., Kenneth C. Schiff, Steven M. Bay July 2001)

^f Data from the Caltrans Stormwater Monitoring & Research Program, Preliminary Report of Discharge Characteristics Studies, CTSW-RT-03-023 (California Department of Transportation March 2003).

Off-site Areas

Off-site pick-up/drop-off areas and new bus layovers areas associated with stations could add vehicular use to the existing pollution generating street surfaces. Because the pollution generating surfaces already exist, the volume of runoff containing contaminants would not increase. However, because traffic patterns in the vicinity of the stations would likely change due to the addition of pick-up/drop-off and bus layover zones, the concentration of pollutants in the runoff may increase slightly at those specific locations. While local discharge points may have a reduction in water quality, the larger downstream receiving waterbody would realize a beneficial impact due to the combined effects of reducing PGIS at stations, providing water quality treatment for many of the stations, and reduction in automobile traffic. In combined sewer areas, the expected impact to surface water bodies would be insignificant, because the stormwater runoff would be treated at the West Point Treatment Plant.

Operations Center

Alternatives

The Operations Center would house numerous maintenance activities (refer to Chapter 3, Project Description and Alternatives, for a complete narrative), including light and heavy maintenance areas, monorail vehicle storage, a vehicle wash facility, receiving/loading and employee parking areas.

Industrial activities would all be contained in the main maintenance and storage building or otherwise enclosed. This includes light and heavy maintenance areas, maintenance equipment storage, and storage of batteries, lubricants, and other hazardous materials. The monorail vehicle wash facility would also be enclosed and would not discharge wash water into the storm system. Therefore, any hazardous materials related to maintenance activities would not be exposed to stormwater should leaks or accidental spills occur.

Activities outside the enclosed structures include employee parking, receiving/loading areas, and possible monorail train storage. Such areas would have the potential to contribute pollutants to stormwater typical to that of other commercial facilities subject to vehicular traffic. Discharges to surface waters of stormwater associated with industrial activities pursuant to 40 CFR 122.26 would be regulated by an industrial stormwater NPDES permit.

For purposes of assessing water quality impacts from the proposed Operations Center alternatives, one-third of the site area was assumed to be pollution generating. The roof material on the Operations Center building is anticipated to be non-pollution generating and is therefore not included in the PGIS estimates (Table 4.14-10).

Table 4.14-10. Operations Center – Pollution Generating Impervious Surface

Operations Center	Existing PGIS (sf)	Proposed New and Replaced PGIS (sf)	Change in PGIS Area (sf)	Percent Change in PGIS	Drainage System
Interbay (Alternative C-1)	175,700	85,800	-89,900	-51%	Completely Separated
SODO (Alternative C-2)	72,000	44,500	-27,500	-38%	Completely Separated

Note: sf = square feet.

Preferred Alternative (Summary of Impacts)

The Preferred Alternative for the Operations Center is the Interbay site (Alternative C-1). The water quality impacts are summarized in Table 4.14-10 above. The Preferred Alternative would have a greater reduction in PGIS from existing site conditions. Alternative C-1 would reduce PGIS by approximately 89,900 square feet, whereas locating the operations center at the SODO site would decrease PGIS by approximately 27,500 square feet.

Guideways and Trains

The trains proposed for the Green Line are anticipated to employ efficient and reliable systems. For every mile traveled, the electric propulsion motors of Green Line trains would replace the main source of pollution—the internal combustion engine—in the urban areas where they would operate. Two types of pollutants may still be released during the operation of the Green Line trains: hydrocarbons and metals (Table 4.14-11).

Table 4.14-11. Potential Pollutants from Monorail Operation

Source	Pollutant	Point of Stormwater Contact	Potential to Impact Surface Water
Guideway			
Power rails	Metals: Copper, Tin, Zinc, Iron, and Chromium	Full length of track	Insignificant discharge based on comparison with existing Metro bus system.
Transit Vehicles			
Train lubricants	Hydrocarbons: Grease	Full length of track	Insignificant discharge due to monorail technology and maintenance program
Standard truck tires	Zinc	Full length of track	Insignificant increase in zinc contribution to receiving water compared to all traffic in the study area.
Standard truck brakes with regenerative braking system	Copper	Full length of track	Insignificant increase in copper contribution to receiving water compared to all traffic in the study area.

Hydrocarbons

Monorail trains have several vehicle systems where moving parts must interface, requiring lubrication with the potential to cause hydrocarbon pollution. A critical component of reliably operating these lubricated systems is to exclude dirt. As a result, bearings and gears are fully enclosed and sealed with virtually no chance to release lubricants to the environment. A review of the technology anticipated for the monorail train systems where potential pollutants are used shows the following measures to suppress pollution are included in the design:

- Sealed housing roller bearings for all axle bearings.
- Self-contained gear units with very long periods of operation between maintenance.
- Totally enclosed and sealed motor bearings.
- Enclosed truck bearings designed to exclude dirt.

- Hydraulic brake systems, which are likely to leak only during maintenance, when pollution control procedures would be employed.
- Sealed door mechanisms.
- Enclosed, sealed electrical contactors.
- On-board batteries contained within sealed enclosures.
- Air conditioners with refrigerant enclosed in a sealed system.

These and other design features reduce the probability that regular monorail train operation would release hydrocarbons to the aquatic environment at adverse levels.

Metals

During operation, monorail trains could potentially generate metal particles that could be contributed to stormwater. Potential sources of metal dust include:

- Use of track-mounted power rails for supplying electricity to the transit vehicles.
- Use of standard truck brakes for the last 10 percent of braking power.
- Use of standard truck tires for propulsion and suspension of transit cars.

The electric motors of the monorail trains would be powered from metal rails mounted on the sides of the guideway beam. The rails would be aluminum with a stainless steel facing, and will be covered with an insulation material. The trains would have collector brushes made from a compound of bronze and graphite. The collector brushes would slide against the stainless steel face of the power rails providing a conductive path for the electrical power to the train. The friction between the moving train and the stationary power rail slowly abrades the power rails, forming small amounts of metal particle dust that can be washed or blown off the guideway and into the stormwater collection system. This conclusion is supported by the need to routinely replace the catenary wires on the Metro bus system (similar abrasive action to the power rail) as it abrades to a pre-defined thickness on a schedule dependent on the number of trips made. Metals that could potentially end up in stormwater include iron and chromium (from the stainless steel facing) and copper, tin, and zinc (from the bronze in the brushes).

Guideway mounted power rails could provide a potential source of copper, and to a lesser extent tin, zinc, iron, and chromium into stormwater from the Green Line. By way of comparison, the proposed monorail propulsion system can be compared to the existing electric Metro bus system currently used in Downtown Seattle. Although the electric buses use a suspended wire catenary system instead of rails, the abrasion principle is the same. The existing Metro bus system has approximately 120 miles of trolley bus routes throughout its entire system (based on 60 miles of two-way wire) (Wolak 1999 personal communication). The total length of guideway for the Green Line would be approximately 28 miles (14 miles each way). This length could be less if segments of the guideway are constructed with a single guideway.

To determine the potential impact of adding copper and other metal sources to the project area, the existing catenary system in the Rainier Valley was examined. The Rainier Valley was chosen based on the availability of stormwater and Duwamish River copper data for this area. Primary existing sources of copper in the Rainier Valley include automobile, bus, and truck brakes, atmospheric deposition, and existing catenary system wires for buses. The existing Metro bus system has approximately 10 miles of routes with catenary system wire in the Rainier Valley. The existing median dissolved copper concentration for the Brandon Street and Hanford Street CSOs to the Duwamish Waterway (data representative of CSOs to the Duwamish and the Ship Canal) are 4.8 µg/L and 5.0 µg/L, respectively. Compared to typical urban and suburban runoff, these concentrations are relatively low (City of Bellevue 1996). Furthermore, surface water in the Duwamish Waterway has very low dissolved copper

concentrations (median value approximately 0.7 µg/L); Ship Canal dissolved copper surface water concentrations are approximately 2.7 µg/L. Adding power rails to this system consisting of multiple copper sources is very unlikely to increase copper or other metal concentrations above the acute and chronic toxicity thresholds for fresh and marine waters (included in Table 4.14-12).

Table 4.14-12. Toxic Thresholds for Power Rail Metals for Fresh and Marine Water ^a

Metal	Freshwater ^b		Marine Water	
	Acute Toxic Concentration (µg/L)	Chronic Toxic Concentration (µg/L)	Acute Toxic Concentration (µg/L)	Chronic Toxic Concentration (µg/L)
Copper	7.8	5.6	4.8	3.1
Chromium	280.1	90.9	-	-
Zinc	57.1	52.1	90.0	81.0

µg/L = micrograms per liter.

a. Tin and iron are not regulated under WAC 173-201A.

b. Freshwater concentrations are derived with a hardness value of 44 mg/l.

Use of standard truck brakes and tires could generate brake pad residue and tire powder, which could contain copper and zinc. As specified pursuant to SMP's environmental sustainability program, the monorail trains will use an efficient regenerative braking system in addition to a conventional internal frictional braking system. The trains will use an electric motor to create torque to drive the wheels. The electric motor can either use electricity to create torque, or reverse the process to use torque to create electricity and in the process slow the train. The regenerative braking system will account for approximately 90 percent of the braking force. Only at very low speeds would the monorail use its friction brakes. This will significantly reduce the amount of copper and zinc that may be contributed to waterways. These residues could also wash off the guideway and into the stormwater conveyance system or directly into water bodies where the monorail alignment would cross open water. Although the Green Line could add small amounts of copper, it is not expected to increase dissolved copper or zinc concentrations above toxic threshold levels in the Duwamish Waterway or the Ship Canal.

The Green Line Guideway Pollutant Loading Analysis (Parametrix 2004), which is incorporated by reference, estimates potential copper and zinc loading rates from the truck brakes and tires from operation of the Green Line trains for a one-year period. Those emissions were then compared to the projected loading rates of all traffic in the study area during the same period. The results of the study indicate that an insignificant increase in copper and zinc emissions within the study area would likely occur from operation of the Green Line, which is not expected to have an adverse impact on receiving waters. The study is summarized below.

A literature search revealed two methods of estimating pollutant emission rates from tire and brake pad wear. The first method was developed by the UNECE Task Force on Emission Inventories and Projections for inclusion in an Automobile tire and brake wear chapter of the *EMEP/CORINAIR Emission Inventory Guidebook*. The second method was developed in a study entitled, "Contribution of Heavy Metals to Stormwater from Automotive Disc Brake Pad Wear" (Woodward Clyde 1994).

Both methods (UNECE and Woodward Clyde) were used together to estimate zinc and copper emissions from operation of the Green Line for a one-year period and those emissions were then compared to the projected loading rates of all traffic in the study area during the same period. The UNECE methodology was used to estimate the tire and brake loading rates from automobile traffic and tire loading rates from the Green Line. The Woodward Clyde methodology was used to estimate the loading rate from the

monorail brake pads because the equation is able to factor in the regenerative braking system used by the monorail trains.

Bridges

The Green Line could cross up to three waterways: the Ship Canal, the Duwamish Waterway, and possibly Longfellow Creek. The Ballard Crossing would be over open water for all alternatives. The Duwamish crossing would be either atop the existing West Seattle Bridge or a separate adjacent bridge. With Alternative 6.1, runoff from the guideway would fall onto the deck of the West Seattle Bridge where it would be collected and discharged into the Duwamish via storm drains. With Alternative 6.2, the guideway would be placed on a separate bridge structure that is not proposed to collect stormwater; therefore, runoff would fall directly into the Duwamish.

There are several alignments through the Delridge neighborhood that cross either the open channel of Longfellow Creek or the storm pipe that conveys the creek from just south of SW Andover Street to its discharge point into the West Duwamish Waterway. Alternative 6.1, (Delridge 1 station) would cross Longfellow Creek diagonally above the open channel of the creek south of SW Andover Street. Alternative 6.2 (Delridge 2 station) is located above SW Andover Street where the creek is enclosed in a pipe.

Alternative 6.3(s), (Nucor station) the Preferred Alternative, would cross the piped segment of Longfellow Creek at SW Spokane Street. Drainage from this area does not enter the Longfellow Creek storm drain until approximately 350 feet upstream of the discharge to the Duwamish. Alternative 6.3(s) is not expected to have a significant adverse impact to Longfellow Creek.

Alternative 6.4 (Delridge 1A station) would cross parallel and approximately 45 feet south of SW Andover Street. This alignment would also cross over the piped portion of the creek in the vegetated area to the south of the street. Alternative 6.4(s) would have the same alignment, but the guideway would consist of a single guideway.

Precipitation dripping from the guideway from the various Delridge Alternatives would either be collected in the storm drain system in SW Andover Street which discharges to the piped segment of Longfellow Creek; or fall into the vegetated area which also drains to the creek; or fall directly into the creek. The vegetation would facilitate removal of any pollutants washed off the guideway through filtration and absorption in much the same way as a bioswale (See Appendix T of the Draft EIS for information on bioswales) and the single guideway alternative would have less frequent train traffic, therefore Alternative 6.4(s) would have the least impact at this location. None of these alignments is expected to have any new significant impact on Longfellow Creek.

Alternative 6.5 (Delridge 4, Genesee) would cross Longfellow Creek within the Genesee right-of-way where the creek is contained in a culvert. Runoff from the guideway would drip onto the street where it would be collected by existing storm drains and discharged into the open channel of the creek on the north side of Genesee. Although the guideway runoff would be discharged along with street runoff into Longfellow Creek for this alternative, no new adverse impact is expected due to the insignificance of the pollutant emissions from tires brake pads.

Wetlands

Impacts to wetlands are not expected to result from operation of the Green Line. Only two small wetlands were found in the area of the Green Line Alternatives. The wetlands are in the West Seattle segment south of SW Andover Street and adjacent to Longfellow Creek. Please refer to the Longfellow Creek Wetland Report in Appendix RR for specific wetland information and an assessment of potential

construction impacts and mitigation. Green Line Alternatives 6.1, 6.2, 6.4, and 6.4(s) each proposes a station on the east side of Longfellow Creek. Because stormwater runoff from this site would enter the storm pipe that conveys Longfellow Creek to the West Duwamish Waterway and not the open channel of the creek, no impact is expected to the existing wetlands.

Alternatives 6.1 would operate a guideway above Wetland A, and Alternatives 6.4, and 6.4(s) would operate a guideway above Wetland B. No new adverse impact is expected to result from operation of Green Line trains to either wetland because pollutant emissions from train tires and brake pads would be insignificant. Please refer to Section 4.15 for discussion of potential impacts to wetland plants and animals.

Traction Power Substations

Traction power substations would be housed in buildings that would range from 1,200 to 2,100 square feet in size, or could be incorporated into stations. The buildings are anticipated to be constructed with non-pollution generating roof material. Vehicular traffic is anticipated to be minimal, as the sites would only occasionally be visited by maintenance personnel. Therefore, the power substations are not anticipated to have a significant adverse impact on water quality.

Impacts From the No Action Alternative

The No Action Alternative would not create any new adverse water quality impacts. However, if the Green Line is not constructed, the positive impacts to stormwater water quality that could result from the project would not be realized. Reduced automobile traffic in the vicinity of the proposed Green Line is expected to occur as a result of the project (refer to Section 4.1, Transportation, for results of vehicle miles traveled reduction analysis). Reduction of automobile use and replacement by electric-powered monorail trains would reduce the amount of pollutants, including oils and grease, metals, and other combustion byproducts, released onto the roadways (and washed away by stormwater runoff) during automobile operation.

Another positive impact that would not be realized if the Green Line is not constructed is the potential improvement to stormwater quality resulting from a reduction of existing pollution generating surfaces on almost all of the proposed station and Operations Center sites. Reduction of PGIS reduces the amount of area subjected to the combination of precipitation and vehicular traffic, which are the two key factors associated with automobile-related polluted runoff.

Operational Mitigation

Station Sites

Potential mitigation measures for water quality impacts to receiving water bodies due to pollution generating impervious surfaces are evaluated for each station location alternative under its respective segment below. Although there are limited (and generally positive) impacts anticipated to water quality from the Green Line alternatives, some mitigation measures are required for any new construction under the Seattle Municipal Code and Ecology Manual. In general, stations that would be constructed in combined sewer areas are not anticipated to require on-site mitigation because water quality treatment would be provided at the West Point Treatment Plant. Stations that would be constructed in partially separated or completely separated sewer areas could provide water quality treatment as required by the *Stormwater Treatment Technical Requirements Manual* (Seattle 2000). Seattle requires that project sites creating 5,000 square feet or more of new PGIS or one acre of accumulative new and replaced PGIS provide a stormwater treatment facility for runoff draining from the pollution generating surfaces. If evaluated individually, some of the station sites would be below the threshold requiring water quality

treatment. However, evaluating the Green Line as a whole and not by each individual component would require water quality treatment if located within a partially or completely separated sewer area.

Water quality treatment could be selected from a list of best management practices (BMPs), including but not limited to biofiltration swale, filter strip, wetpond, wetvault, stormwater wetland, media filter, or infiltration as listed in the *Stormwater Treatment Technical Requirements Manual* (Seattle 2000) and the guidance of the 2001 Ecology Manual. (See Appendix T of the Draft EIS, Water Quality Treatment Best Management Practices, for BMP descriptions.) Due to limited space at most of the station location alternatives, treatment could be provided by underground wetvaults. Other possible methods of treatment for station sites include media filters, bioswales, and infiltration. Seattle requires water quality treatment facilities to be designed to treat runoff from a 6-month storm. Facilities such as bioswales, which are designed according to the rate of stormwater flow, would be designed to treat the peak flow from the six-month storm. Facilities such as wetvaults, which are designed based on volume, would be sized to contain three times the volume of the mean annual storm. The mean annual storm is defined as the annual rainfall divided by the number of storm events in a year. The Green Line does not expect to infiltrate groundwater from any operational components of the system. However, if groundwater were infiltrated, it would need to meet groundwater quality standards and other regulatory requirements, including Ecology requirements.

Segment 1 - Ballard Segment

Alternatives

Station alternatives within the Ballard Segment would mostly be located in combined sewer areas. On-site water quality treatment would not be required for these stations, as off-site treatment would be provided at the West Point Treatment Plant. All four station alternatives at the NW Market location would be located in a partially separated sewer area and may require on-site water quality mitigation (Table 4.14-13).

Table 4.14-13. Ballard Segment – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 1.1 or 1.1(s) - West Side of 15th				
Crown Hill 1 (West, 85 th)	1,900	None	N/A	Combined Sewer Area
Crown Hill 1A	1,900	None	N/A	Combined Sewer Area
NW 65 th 1 (West)	1,900	None	N/A	Combined Sewer Area
NW 65 th 1A (West)	1,900	None	N/A	Combined Sewer Area
NW 65 th 1B (West)	1,900	None	N/A	Combined Sewer Area
NW Market 1 (Southwest)	28,000	Water Quality BMP	2,020	Partially Separated Area
NW Market 3 (Northwest)	1,900	Water Quality BMP	140	Partially Separated Area
NW Market 3A (NW)	41,900	Water Quality BMP	3,000	Partially Separated area
Alternative 1.2 - Center of 15th				
Crown Hill 2 (Center)	1,900	None	N/A	Combined Sewer Area
NW 65 th 2 (Center)	1,900	None	N/A	Combined Sewer Area
NW Market 2 (Center)	27,000	Water Quality BMP	1,950	Partially Separated Area

Note: sf = square feet.

Preferred Alternative (Summary of Mitigation)

A summary of mitigation measures anticipated for the Preferred Alternative in the Ballard Segment is presented in Table 4.14-13a. Only one of the three stations, being located in a partially separated sewer area, would likely require on-site mitigation. The other two stations are located in combined sewer areas and would receive water quality treatment at the West Point Treatment Plant. The NW Market station site would require water quality mitigation in varying amounts depending on the alternative selected. The Preferred Alternative would require water quality treatment for approximately 3,000 cubic feet of stormwater. Alternative 1.1 would also require treatment for up to 3,000 cubic feet of stormwater, and Alternative 1.2 would require treatment for approximately 1,950 cubic feet of stormwater.

Table 4.14-13a. Ballard Segment Preferred Alternative – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Crown Hill 1A (West, 85 th)	1,900	None	N/A	Combined Sewer Area
NW 65 th 1B (West)	1,900	None	N/A	Combined Sewer Area
NW Market 3A (NW)	41,900	Water Quality BMP	3,000	Partially Separated Area

Segment 2 – Interbay/Magnolia Segment

Alternatives

Station alternatives within the Interbay/Magnolia Segment would also mostly be located in combined sewer areas. On-site water quality treatment would not be required for these stations, as off-site treatment would be provided at the West Point Treatment Plant. Both the Howe 1 (West) and the Howe 2 (Center) alternatives would be located in a partially separated sewer area and may require on-site water quality mitigation (Table 4.14-14).

Table 4.14-14. Interbay/Magnolia Segment – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 2.1 or 2.1(s) – West Side of 15th/Center of Elliott				
Dravus 1 (16 th)	6,100	None	N/A	Combined Sewer Area
Dravus 1A (16 th)	13,900	None	N/A	Combined Sewer Area
Dravus 1B (Barrett)	0	None	N/A	No PGIS
Howe 1(West)	1,900	Water Quality BMP	140	Partially Separated Area
Future – Howe 1A (Blaine)	0	None	N/A	No PGIS
Elliott & Mercer 1 (Center)	1,900	None	N/A	Combined Sewer Area
Elliott & Mercer 1A (Center)	1,900	None	N/A	Combined Sewer Area

**Table 4.14-14. Interbay/Magnolia Segment – Potential Water Quality Mitigation Measures
(continued)**

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 2.2 - Center of 15th/West Side of Elliott				
Dravus 2 (15 th)	1,900	None	N/A	Combined Sewer Area
Howe 2 (Center)	1,900	Water Quality BMP	140	Partially Separated Area
Prospect 3 (West)	11,400	None	N/A	Combined Sewer Area
Elliott and Mercer 2 (West)	1,900	None	N/A	Combined Sewer Area

Note: sf = square feet.

Preferred Alternative (Summary of Mitigation)

A summary of mitigation measures anticipated for the Preferred Alternative in the Interbay/Magnolia Segment is presented in Table 4.14-14a. None of the three stations would likely require on-site mitigation as they are either located in combined sewer areas and would receive water quality treatment at the West Point Treatment Plant, or they do not create any new or replaced PGIS. Comparatively, Alternative 2.1 and 2.2 could each require water quality treatment of up to 140 cubic feet of stormwater.

Table 4.14-14a. Interbay/Magnolia Segment Preferred Alternative– Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Dravus 1B (Barrett)	0	None	N/A	No PGIS
Future – Howe 1A (Blaine)	0	None	N/A	No PGIS
Elliott & Mercer 1A (Center)	1,900	None	N/A	Combined Sewer Area

Segment 3 - Queen Anne/Seattle Center/Belltown Segment

Alternatives

No water quality mitigation is anticipated for any of the station alternatives in the Queen Anne/Seattle Center/Belltown Segment because stations either are not anticipated to create any new or replaced PGIS, or are located within combined sewer areas. Seven of the station alternatives are not anticipated to construct any new or replaced PGIS and four are anticipated to create approximately 1,900 square feet for technical staff and security parking, but are located in combined sewer areas where water quality treatment would be provided at the West Point Treatment Plant (Table 4.14-15).

**Table 4.14-15. Queen Anne/Seattle Center/Belltown Segment –
Potential Water Quality Mitigation Measures**

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 3.1 – Seattle Center/Republican				
Seattle Center/Queen Anne 1 (North)	0	None	N/A	No PGIS
Seattle Center/ Queen Anne 1A (North)	0	None	N/A	No PGIS
Seattle Center/Fifth & Broad 1	1,900	None	N/A	Combined Sewer Area
Seattle Center/Fifth & Broad 1A	1,900	None	N/A	Combined Sewer Area
Belltown 1 (Center-West)	0	None	N/A	No PGIS
Belltown 1A (Center-West)	0	None	N/A	No PGIS
Belltown 2 (Center-East)	0	None	N/A	No PGIS
Alternative 3.2 – Mercer				
Seattle Center/Queen Anne 1 (North)	0	None	N/A	No PGIS
Seattle Center/ Queen Anne 1A (North)	0	None	N/A	No PGIS
Seattle Center/Fifth & Broad 1A	1,900	None	N/A	Combined Sewer Area
Seattle Center/Fifth & Broad 2 (Harrison)	1,900	None	N/A	Combined Sewer Area
Belltown 3 (West)	0	None	N/A	No PGIS
Alternative 3.3 – Thomas				
Seattle Center/Queen Anne 2 (South)	0	None	N/A	No PGIS
Seattle Center/Fifth & Broad 1	1,900	None	N/A	Combined Sewer Area
Seattle Center/Fifth & Broad 1A	1,900	None	N/A	Combined Sewer Area
Belltown 1 (Center-West)	0	None	N/A	No PGIS
Belltown 1A (Center-West)	0	None	N/A	No PGIS
Belltown 2 (Center-East)	0	None	N/A	No PGIS
Alternative 3.5 – Second/Denny				
Seattle Center/Queen Anne 2 (South)	0	None	N/A	No PGIS
Denny 3	1,900	None	N/A	Combined Sewer Area
Belltown 1 (Center-West)	0	None	N/A	No PGIS
Belltown 1A (Center-West)	0	None	N/A	No PGIS
Belltown 2 (Center-East)	0	None	N/A	No PGIS

Note: sf = square feet.

Preferred Alternative (Summary of Mitigation)

A summary of mitigation measures anticipated for the Preferred Alternative in the Queen Anne/Seattle Center Segment is presented in Table 4.14-15a. None of the three stations would likely require on-site mitigation as they are either located in combined sewer areas and would receive water quality treatment at the West Point Treatment Plant, or they do not create any new or replaced PGIS. Similarly, the other alternatives would not require on-site water quality mitigation.

**Table 4.14-15a. Queen Anne/Seattle Center/Belltown Segment Preferred Alternative–
Potential Water Quality Mitigation Measures**

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 3.1 – Seattle Center/Republican				
Seattle Center/ Queen Anne 1A (North)	0	None	N/A	No PGIS
Seattle Center/Fifth & Broad 1A	1,900	None	N/A	Combined Sewer Area
Belltown 1A (Center-West)	0	None	N/A	No PGIS

Segment 4 – Downtown/Pioneer Square Segment

Alternatives

No water quality mitigation is anticipated for any of the station alternatives in the Downtown/Pioneer Square Segment. Only two downtown stations would create any new or replaced PGIS. Pike 2A (East Center) and Madison 2A (East Center) of Alternative 4.4 (East Center of Second) would each add approximately 1,400 square feet of technical staff and security parking. Both of these stations would be located in a combined sewer area and would therefore, not provide on-site water quality mitigation. (No table provided).

Preferred Alternative (Summary of Mitigation)

The stations included in the Preferred Alternative are Fifth and Stewart 2A (Virginia Center), Pike 1 (West) B, Madison 1 (West), and Yesler 1 (West). None of the stations would create any new or replaced PGIS and therefore, would not require mitigation. (No table provided). Similarly, the other alternatives would not require on-site water quality mitigation.

Segment 5 – SODO/Chinatown International District/Pioneer Square Segment

Alternatives

Within the SODO/Chinatown International District/Pioneer Square Segment, all of the Lander station alternatives are anticipated to require water quality mitigation because they would create new and replaced PGIS for technical staff and security parking (Table 4.14-18). Mitigation for the Lander 4 site is evaluated here for operation of a station only, and not the Operations Center that could also occupy this site. (Mitigation for the Operations Center is analyzed below in Table 4.14-16.) The remaining three sites would not be required to provide water quality mitigation, because no PGIS would be created on the station sites.

Preferred Alternative (Summary of Mitigation)

A summary of mitigation measures anticipated for the Preferred Alternative in the SODO/Chinatown International District/Pioneer Square Segment is presented in Table 4.14-16a. Only the Lander 3 (Diagonal) station is likely to require on-site water quality mitigation since it is located in a partially separated sewer area. The other two stations would not create any new or replaced PGIS. The Preferred Alternative and Alternative 5.2 would each require water quality treatment of approximately 580 cubic feet of stormwater. Alternative 5.1 would require treatment of a maximum of 740 cubic feet depending on the station selected in the Lander area.

Segment 6 - West Seattle Segment

Alternatives

Within the West Seattle Segment, the Delridge 1, 1A, and 2 station alternatives may require water quality mitigation. In addition to the standard treatment methods listed above, the Ecology Manual may require enhanced treatment of stormwater for the Delridge alternatives located adjacent to Longfellow Creek. Enhanced treatment provides a higher pollutant removal rate through use of a large sand filter, amended sand filter, stormwater treatment wetland, infiltration with appropriate pretreatment, or a two-facility treatment train. Enhanced treatment is required by Ecology for larger projects that discharge stormwater within ¼ mile of a fish-bearing stream—in this case Longfellow Creek. The other station alternatives that create new or replaced PGIS and are located outside of combined sewer areas would also require on-site water quality treatment (Table 4.14-17).

Preferred Alternative (Summary of Mitigation)

A summary of mitigation measures anticipated for the Preferred Alternative in the West Seattle Segment is presented in Table 4.14-17a. The Morgan Junction 1A (West) station would likely require on-site mitigation because it would create PGIS and is located in a partially separated sewer area. The other three stations would not likely require on-site mitigation because they are either located in combined sewer areas and would receive water quality treatment at the West Point Treatment Plant, or they do not create any new or replaced PGIS. The Preferred Alternative would require water quality mitigation for approximately 140 cubic feet of on-site stormwater. Comparatively, Alternatives 6.1 and 6.2 would require mitigation for approximately 2,440 and 650 cubic feet of stormwater respectively; these numbers could vary depending on the station selected for the Delridge subsegment.

Table 4.14-16. SODO/Chinatown ID/Pioneer Square – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 5.1 - East Side of Third/Utah				
Weller/King Street 1 (Standard)	0	None	N/A	No PGIS
Safeco Field 1	0	None	N/A	No PGIS
Lander 1 (Northeast)	6,000	Water Quality BMP	430	Partially Separated Area
Lander 2 (Southwest)	10,300	Water Quality BMP	740	Partially Separated Area
Lander 4 (Utah)	1,900	Water Quality BMP	140	Completely Separated Area

Table 4.14-16. SODO/Chinatown ID/Pioneer Square – Potential Water Quality Mitigation Measures (continued)

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 5.2 - West Side of Third/Utah (or 5.2(s) with addition of Safeco Station)				
Weller/King Street 2 (Event)	0	None	N/A	No PGIS
Safeco Field 1	0	None	N/A	No PGIS
Lander 3 (Diagonal)	8,000	Water Quality BMP	580	Partially Separated area

Note: sf = square feet

Table 4.14-16a. SODO/Chinatown ID/Pioneer Square Preferred Alternative – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Weller/King Street 2 (Event)	0	None	N/A	No PGIS
Safeco Field 1	0	None	N/A	No PGIS
Lander 3 (Diagonal)	8,000	Water Quality BMP	580	Located in Partially Separated area

Table 4.14-17. West Seattle Segment – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Alternative 6.1 - West Seattle I				
Delridge 1 (26 th)	32,000	Water Quality BMP	2,300	Partially Separated Area
Avalon 1 (Center)	1,900	None	N/A	Combined Sewer Area
Alaska Junction 1 (42 nd /Edmunds)	1,900	None	N/A	Combined Sewer Area
Alaska Junction 1A (42 nd /Edmunds)	1,900	None	N/A	Combined Sewer Area
Morgan Junction 1 (West)	1,900	Water Quality BMP	140	Partially Separated Area
Morgan Junction 1A (West)	1,900	Water Quality BMP	140	Partially Separated area
Alternative 6.2 – West Seattle II				
Delridge 2 (Andover)	5,100	Water Quality BMP	370	Partially Separated Area
Avalon 2A (35 th)	0	None	N/A	No PGIS
Avalon 2B (35 th)	0	None	N/A	No PGIS
Alaska Junction 2 (44 th /California)	1,900	Water Quality BMP	140	Partially Separated Area

Table 4.14-17. West Seattle Segment – Potential Water Quality Mitigation Measures (continued)

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Morgan Junction 2 (Center)	1,900	Water Quality BMP	140	Partially Separated Area
Alternative 6.3(s) – Delridge North Subsegment				
Delridge 3 (Nucor)	0	None	N/A	No PGIS
Alternative 6.4 –Andover/Yancy Subsegment				
Delridge 1A (26th)	38,100	Water Quality BMP	2,740	Partially Separated area
Alternative 6.4(s) –Andover/Yancy Subsegment single beam				
No Station	N/A	N/A	N/A	N/A
Alternative 6.5 – Genesee Subsegment				
Delridge 4 (Genesee)	0	None	N/A	No PGIS

Note: sf = square feet.

Table 4.14-17a. West Seattle Segment Preferred Alternative – Potential Water Quality Mitigation Measures

Station	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Delridge 3 (Nucor)	0	None	N/A	No PGIS
Avalon 2B (35th)	0	None	N/A	No PGIS
Alaska Junction 1 (42 nd /Edmunds)	1,900	None	N/A	Combined Sewer Area
Morgan Junction 1A (West)	1,900	Water Quality BMP	140	Partially Separated area

Off-site Areas

The Seattle Stormwater Code requires retrofitting for flow control and water quality treatment caused by off-site areas only if existing impervious surface is removed down to earth and replaced with impervious and/or pollution generating surface. Increased usage of existing PGIS does not trigger retrofitting an existing storm drainage system. Because bus zones and pick-up/drop-off areas would occur on existing off-site PGIS, mitigation would not be required for those off-site activities.

Operations Center

Alternatives

Either Operations Center alternative could be mitigated using a water quality BMP selected from the same list as provided for the station sites. Either Operations Center would require on-site water quality mitigation as they would both be located in completely separated sewer areas (Table 4.14-18).

Table 4.14-18. Operations Center – Potential Water Quality Mitigation Measures

Location	New and Replaced PGIS (sf)	Mitigation	Estimated Treatment Runoff Volume (cubic feet)	Reason
Interbay (Alternative C-1)	85,800	Water Quality BMP	6,200	Completely Separated Area
SODO (Lander 4) (Alternative C-2)	44,550	Water Quality BMP	3,200	Completely Separated Area

Note: sf = square feet.

^a Operations Centers have not yet been designed; it was assumed that one-third of the site would be PGIS.

Preferred Alternative (Summary of Mitigation)

The Preferred Alternative for the Operations Center is the Interbay site (Alternative C-1). Mitigation measures are summarized in Table 4.14-18 above. The Preferred Alternative would require water quality mitigation for approximately 6,200 cubic feet of on-site stormwater and Alternative C-2 would require mitigation of approximately 3,200 cubic feet of stormwater.

Guideways and Trains

New impacts to water quality of receiving water bodies resulting from operation of guideways and trains are expected to be negligible. Therefore, no water quality mitigation is proposed.

Bridges

During bridge permitting, the project must obtain a Section 401 Water Quality Certification from Ecology, which requires reasonable assurance that water quality standards will be met. The Section 401 Water Quality Certification will be conditioned with mitigation measures imposed by the Washington State Department of Ecology. No additional operational water quality mitigation is proposed for the Green Line bridges. As discussed above, new water quality impacts from the operation of the Green Line are expected to be negligible.

A Hydraulic Project Approval (HPA) for bridge maintenance would likely be required. Maintenance of the bridges (e.g., painting, washing, and general repair) would be completed as necessary. Washington Department of Fish and Wildlife (WDFW) has developed BMPs to protect state waters during maintenance activities. The HPA for Statewide Bridge and Ferry Terminal Cleaning, Painting, General Maintenance and Repair is included in Appendix T of the Draft EIS, Water Backup Information, and provides a list of possible activities and associated BMPs.

Traction Power Substations

No significant impacts to water quality are anticipated from the traction power substations; however, because water quality thresholds are evaluated for the entire project as a whole, mitigation is anticipated for sites that create new or replaced PGIS and are located outside of combined sewer areas. A typical 7,000-square-foot site with a 1,500-square-foot non-PGIS building could create 5,500 square feet of PGIS (conservative estimate). Such a site would require approximately 400 cubic feet of water quality treatment volume.

No Action Alternative

No mitigation would be provided for the No Action Alternative as no new impacts would result if the Green Line were not constructed.

4.14.4.4 Surface Water Quantity

Operational Impacts

The total volume of runoff as well as the rate of runoff can increase when vegetation is removed, soils are compacted or removed, and impervious surfaces (including buildings, streets, parking lots, and sidewalks) are constructed. Changes in the hydrologic regime can result in increased frequency and duration of high stream flows that lead to stream bank erosion, channel scouring, and loss of hydraulic complexity. During the dry summer months, reduced groundwater recharge can result in loss of base flows during dry periods, with potential long-term consequences, including loss and degradation of aquatic habitat.

This section analyzes the potential impacts of operation of the Green Line alternative alignments. The possible effects on receiving water bodies due to increased impervious surface area depend on the type of receiving water body. The definition and importance of impervious surfaces is discussed below.

Receiving water bodies can be divided into two categories:

- **Designated receiving water:** Designated receiving waters are defined in the *Flow Control Technical Requirements Manual* (Seattle 2000) as having the capacity to receive drainage discharges. Designated water bodies that receive runoff from the area of the Green Line alternative alignments include the Ship Canal, Lake Union, Elliott Bay, the Duwamish Waterway, and Puget Sound. These water bodies are either marine, tidally influenced, or have controlled surface elevation. Thus, increasing the quantity of stormwater runoff does not result in flooding, erosion, or impaired aquatic habitat.
- **Non-designated receiving water:** Non-designated receiving waters include all other water bodies not included in Seattle's designated receiving water list. Non-designated waters do not have the capacity to receive unmitigated stormwater runoff without suffering the adverse effects of flooding, erosion, or impaired aquatic habitat due to changes in runoff quantity patterns. Within the area of the Green Line alternative alignments, Longfellow Creek is the only water body not defined by the City as a designated receiving water. Potential effects specific to Longfellow Creek are discussed below under the West Seattle Segment.

The possible effects of increased impervious surface area also depend on the type of drainage system collecting the runoff. Increased volumes of runoff and higher peak rates can have an adverse effect on combined sewer systems by increasing the probability of the system to exceed its conveyance capacity more frequently. This can result in increased amounts of combined sewage and stormwater discharged into receiving water bodies. Actual pipe capacity will be analyzed for each individual station and Operations Center during the design process once the specific discharge locations have been determined. Effects of CSOs are discussed in the Water Quality section.

In partially separated systems, any potential impacts would occur to the storm system only. Because all new impervious surfaces are connected to the storm system, no detrimental effects would occur to the combined sewer system. Where existing buildings connected to the combined system would be removed, a reduction of stormwater discharge to the combined system would also occur. A reduction in discharge to the combined sewer system would benefit the system by decreasing the possibility of CSOs occurring. Runoff from new impervious surfaces draining to the storm system could cause capacity problems in the pipe network and could also have negative impacts on downstream receiving waters. The potential

effects of exceeding pipe capacity in storm systems include damage to the system and flooding and property damage. Combined sewers have an additional potential effect of discharging raw sewage into receiving water bodies during overflow conditions.

In areas where the sanitary sewer and storm drains are completely separated, potential impacts could occur via the stormwater system both within the conveyance system itself and to downstream receiving waters, including flooding, erosion, sedimentation, and degradation of water quality. Effects to downstream receiving waters are only likely for non-designated receiving waters.

Impervious surface as defined in the 2001 Ecology Manual, is, “A hard surface that prevents or retards the entry of water into the soil...”. From this definition, impervious surfaces proposed for the Green Line would include stations, Operations Center, traction power substations, and guideway columns. Runoff from these facilities would be collected and routed to the storm or combined sewer systems.

Green Line features that do not meet the above definition of impervious surface include guideways and bridges. These structures do not collect rainfall into a storm system, nor do they increase the rate or volume of stormwater runoff to the receiving system above existing conditions and thus do not have any impact on the receiving storm system or water bodies.

Stations

Station alternatives within each Green Line segment were analyzed for increases in impervious surface area (Tables 4.14-19 through 4.14-24). Existing impervious surface areas were estimated based on digital ortho-rectified aerial photographs for all station and Operations Center alternatives (Walker 2003). Conceptual layouts of station and Operations Center sites assume land use to be 100 percent impervious surface area. Specifically, they assume no landscaping, which would certainly be an element of all stations. This conservative impervious surface area assumption results in the greatest estimated impact on receiving water bodies and conveyance systems. The difference between existing and proposed impervious surface area is an indication of the unmitigated impact that each station alternative could have on the affected environment. The greater the area of impervious surface added, the greater the potential impact.

Seattle is a highly urbanized watershed with very high percentages of impervious surface along the Green Line alternative alignments. The Queen Anne/Seattle Center/Belltown, Downtown, and SODO Segments would experience only a small increase in impervious surface area from the operation of the stations (less than 10 percent). Therefore, the impacts due to increased quantity of stormwater runoff over existing conditions would be expected to be relatively minor. Segments located further from the downtown area, including Ballard, Interbay, and West Seattle, typically have lower percentages of impervious surfaces on existing sites. Therefore, replacing the existing land uses with proposed stations sites (assumed to be 100 percent impervious) would result in greater increases in impervious area within these segments. If unmitigated, increases in impervious area could cause detrimental effects to receiving waters or the combined sewer. However, water quantity mitigation would be provided in these instances.

Segment 1 - Ballard Segment

Alternatives

Within the Ballard Segment of the Green Line, alignment Alternatives 1.1, 1.1(s), and 1.2 analyzed three station locations and approximately 14,000 lineal feet of track in each direction. Alternative 1.1(s) would have segments of single track between stations. Therefore, the total length of guideway beam would be less. Potential station locations in Alternative 1.1 or 1.1(s) (West Side of 15th) would increase impervious

surface area over existing conditions by approximately five percent. Alternative 1.2 (Center of 15th) would increase impervious surface by approximately 26 percent.

The Crown Hill station location alternatives are located in combined sewer areas (Table 4.14-19). Combined sewage and stormwater effluent is conveyed to the West Point Treatment Plant for water quality treatment and then discharged into Puget Sound. The CSO for the drainage basin discharges into the Ship Canal at Salmon Bay. Alternatives for the NW 65th station would be located in the same combined sewer system. All four NW Market Street station alternatives are located in a partially separated sewer area. Stormwater from the area discharges into the Ship Canal and the combined sewer flows to the West Point Treatment Plant with the CSO discharging into the Ship Canal.

As mentioned above, the water elevations in the Ship Canal are controlled by the Ballard Locks. Therefore, any additional runoff that may result from the project is not anticipated to cause any quantity-related impacts to the Ship Canal, such as flooding or erosion. However, unmitigated flows could increase the risk of CSO occurrences to the Ship Canal for Alternative 1.2. Possible water quality impacts are discussed in the next section.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative (Alternative 1.1(s)) are summarized in Table 4.14-19a. Overall, the stations would increase impervious surface over existing site conditions by approximately six percent. This compares with an increase of five percent for Alternative 1.1 and a 26 percent increase, as described above, for Alternative 1.2. Most of the increase in the Preferred Alternative occurs in a partially separated sewer area where no significant impact would be expected as the system discharges to a designated receiving water.

Segment 2 – Interbay/Magnolia Segment

Alternatives

Within the Green Line's Interbay/Magnolia Segment, Alternative 2.1 analyzed three station locations and approximately 12,000 lineal feet of track in each direction (Table 4.14-20). Alternative 2.2 also analyzed three station locations and approximately the same length of track. Alternative 2.1(s) would have the same number of stations; however, segments of guideway between stations would consist of a single track. Therefore, the total length of guideway beam would be less. All station locations in Alternative 2.1 would increase impervious surface, with Dravus 1B (Barrett) having the greatest increase. For Alternative 2.2, Dravus 2 (15th) and Howe 2 (Center) would increase impervious surface area and Prospect 3 (West) and Elliott and Mercer 2 (West) would not have significant increases.

All of the Dravus station alternatives are located in a combined sewer area. The combined wastewater and stormwater are conveyed to the West Point Treatment Plant. The CSO for the combined system is also located at West Point. Howe station alternatives 1, 1A, and 2 are located in partially separated sewer areas, with the storm drain outfall discharging into Elliott Bay. The Prospect 3 station is located in a combined sewer area, with the CSO located at West Point. The Elliott and Mercer station options are both located in a combined sewer area, with the CSO located at Elliott Bay. Unmitigated impacts from stormwater quantity changes are expected to be greater from Alternative 2.1.

The quantity of stormwater discharge from the project area would not have an impact on flooding, erosion, or other quantity-related impacts to Elliott Bay or Puget Sound because both are large, marine water bodies.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative are summarized in Table 4.14-20a. Overall, the stations would increase impervious surface over existing site conditions by approximately 84 percent. About half of the new impervious surface would occur in a combined sewer area. If unmitigated, the resulting increase in flows to the combined system could slightly increase the likelihood of CSO occurrences. The other half of the new impervious surface would occur in a partially separated sewer area where no significant impact would be expected as the system discharges to a designated receiving water. This compares to a 69 percent increase for Alternative 2.1 or 2.1(s) and a 22 percent increase for Alternative 2.2.

Segment 3 - Queen Anne/Seattle Center/Belltown Segment

Alternatives

Within the Green Line's Queen Anne/Seattle Center/Belltown Segment, each of the four alternative alignments analyzed three station locations (Table 4.14-21). Alternatives 3.1, 3.2, 3.3, and 3.5 would add approximately 7,300, 8,800, 6,900, and 6,800 lineal feet of track in each direction, respectively. The current land use within this segment where stations would be located is mostly impervious surface. Consequently, only two station alternatives would increase impervious surface area by more than 10 percent: Seattle Center/Queen Anne 2 (South) and Denny 3.

The Seattle Center/Queen Anne 1 and 1A (North) station alternatives are located within a combined sewer area, with the CSO discharging to Elliott Bay. Seattle Center/Queen Anne 2 (South) is located within the Seattle Center drainage system, which is partially separated. However, the storm pipes flow into the combined sewer system east of the Seattle Center. The CSO for this station discharges to Lake Union. The three Seattle Center/Fifth and Broad station location alternatives would be located within a combined sewage area that overflows to Lake Union. The three Belltown station alternatives are in the same combined sewer area. The Denny 3 station alternative would be located within a combined sewer area, with the CSO discharging to Elliott Bay.

None of the alternatives would have significant quantity-related adverse impacts on receiving water bodies due to the large size of Lake Union and Elliott Bay, both of which are designated receiving waters. However, if unmitigated, the alternatives could differ in their impacts to the CSO system. Alternatives 3.1 and 3.2 would have the least impact. Although small relative to the CSO basin, Alternatives 3.3 and 3.5 would have similar impacts to the combined sewer.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative are summarized in Table 4.14-21a. Each of the stations would drain into the combined sewer system and none of the stations would increase impervious surface over existing site conditions. Therefore, no adverse impact to the combined sewer system would be expected. Comparatively, Alternatives 3.1, 3.2, 3.3, and 3.5 would increase impervious surface area by 3 percent, 1 percent, 7 percent, and 9 percent respectively.

Segment 4 – Downtown/Pioneer Square Segment

Alternatives

Each of the Downtown/Pioneer Square Segment alternatives analyzed four station location alternatives (Table 4.14-22). All three alignment alternatives would add approximately 6,700 lineal feet of rail in each direction. With the exception of Madison 2 (East) and Madison 2A (East Center), which would

increase impervious surface by approximately 18 percent and 15 percent respectively, all other station alternatives would not increase impervious surface above existing conditions because existing sites are already covered by impervious surfaces.

The five station alternatives at Fifth and Stewart would all be located in a combined sewer area, with the CSO discharging to Lake Union. All remaining station location alternatives in the Downtown/Pioneer Square Segment are also located in combined sewer areas; however, the CSOs discharge to Elliott Bay. The only increase in flows to the combined system would be from Alternatives 4.2 and 4.4. If unmitigated, increased flows could slightly increase risk of CSO occurrences in Elliott Bay. Elliott Bay exceeds criteria for fecal coliform and additional CSOs could contribute fecal coliform.

For all stations in the Downtown/Pioneer Square Segment, stormwater would be conveyed to the West Point Treatment Plant. Therefore, under normal conditions, no increase in runoff would occur to either Lake Union or Elliott Bay. Because Alternatives 4.1 and 4.3 would not increase impervious surface area and consequently discharge to the combined sewer system, the capacity of the combined sewer would not be affected. Alternatives 4.2 and 4.4 would each increase impervious surface at the station sites by a total of approximately 3 percent and is not likely to cause additional CSO occurrences.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative are summarized in Table 4.14-22a. None of the stations would increase impervious surface above existing site conditions and therefore, would not have any quantity related impacts. Similarly, Alternatives 4.1 and 4.3 would not increase impervious surface area. Alternatives 4.2 and 4.4 would each increase impervious surface area by approximately 3 percent.

Segment 5 – SODO/Chinatown International District/Pioneer Square Segment

Alternatives

Alternative 5.1 analyzed three station location alternatives in the SODO/Chinatown International District/Pioneer Square Segment (Table 4.14-23). Alternative 5.2 analyzed two station location alternatives, Weller/King Street 2 and Lander 3. Alternative 5.2(s) follows the alignment of Alternative 5.2 with sections of single beam configuration, but includes three stations. Alternative 5.1 would add approximately 11,000 lineal feet of rail in each direction; Alternative 5.2 would add 10,400 lineal feet of rail in each direction, with less total beam length for Alternative 5.2(s). None of the station alternatives would result in an increase in impervious surface area because all of the sites are currently 100 percent impervious.

The Weller/King Street station alternatives would be located in combined sewer areas, with CSOs discharging to Elliott Bay. The Safeco Field station alternative would also be located in a combined sewer area overflowing to Elliott Bay. The Lander 1, 2, and 3 station alternatives would be located in a partially separated sewer area. The overflow from the combined sewer discharges to Elliott Bay, as does the stormwater. The Lander 4 station alternative would be located in a completely separated area. Stormwater from within the completely separated area also discharges into Elliott Bay. Because there would be no increase in flows to the combined system, overflow occurrences would not increase due to the Green Line alternatives.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative are summarized in Table 4.14-23a. None of the stations would increase impervious surface above existing site conditions and therefore, would not have any quantity related impacts. Similarly, none of the other alternatives would increase impervious surface area above existing conditions.

Segment 6 - West Seattle Segment

Alternatives

Alternatives 6.1 and 6.2 each analyzed four station location alternatives in the West Seattle Segment of the Green Line. Alternative 6.1 would add approximately 20,600 lineal feet of rail in each direction. Alternative 6.1(s), 6.3(s), and 6.4(s) would have various guideway segments that consist of a single beam, which would result in less beam length. Alternative 6.2 would add 21,700 lineal feet in each direction.

Runoff from Delridge station alternatives 1 and 2 would drain into the piped storm system that conveys Longfellow Creek to the West Duwamish Waterway. Because stormwater from the station site would not be discharged to the open channel, degradation of the stream channel due to increases in frequency and duration of high flows is not likely. Increased flows could contribute to an over-capacity condition in the culvert, which could result in local flooding upstream of the culvert.

Four subsegment alignment refinements for the Delridge area have been added to this Final EIS to respond to comments about positioning the proposed Delridge station adjacent to Longfellow Creek. Alternative 6.3(s) (Nucor), the Preferred Alternative, evaluates a station north of the Nucor steel plant. This station would be located in a partially separated sewer area. Stormwater from this site would discharge at the West Duwamish outfall, combining with the pipe conveying flow from Longfellow Creek approximately 350 feet upstream of the outfall. Alternative 6.4 evaluates the Delridge 1A (26th) station on the same site as the Delridge 1 and 2 station alternatives, although, the guideway associated with this station alternative would cross parallel and approximately 45 feet south of SW Andover Street. This station would have the same unmitigated water quantity impact as the Delridge 1 station. Alternative 6.4(s) (Andover/Yancy single beam) evaluates a “no station” alternative with a single beam configuration along the same guideway alignment as Delridge 1A. This alternative would not have any impact on water quantity since no station would be built. Alternative 6.5 (Genesee) evaluates a station approximately 750 feet from Longfellow Creek. This station would be located in a combined sewer area, with the overflow discharging into the pipe containing Longfellow Creek at SW Andover Street and finally entering the West Duwamish Waterway.

The station alternatives being analyzed for the Avalon station lie within a combined sewer area, with the CSO discharging into the West Duwamish Waterway. The Alaska Junction 1 and 1A station alternatives would be located in a combined sewer area, with the CSO discharging to the West Duwamish Waterway. The Alaska Junction 2 station would be located in a partially separated sewer area. Stormwater from this area drains into Puget Sound, as does the CSO from the combined sewer. The three station alternatives at the Morgan Junction would be located within a partially separated sewer area, with the stormwater and CSO discharging into Puget Sound.

All station alternatives, except for Morgan Junction 1 and 1A (West), would result in an increase in impervious surface area. Changes in impervious surface area are summarized in Table 4.14-24. If unmitigated, Alternatives 6.1, 6.2, and 6.4 could cause impacts due to increased flows in the Longfellow Creek storm pipe. Alternative 6.3(s), if unmitigated, could increase peak velocities and increase durations of high velocities that could make passage up the culvert more difficult for migrating salmon and other fish species. Alternative 6.5 (Genesee), if unmitigated, could have an impact on the combined sewer system, which could increase the frequency and duration of CSO occurrences to the West Duwamish Waterway. The Duwamish currently exceeds the fecal coliform water quality standard and additional CSO discharges could further increase fecal coliform levels.

Floodplain

The western edge of Delridge Station Alternatives 1, 1A, and 2 could possibly encroach into the FEMA 100-year floodplain boundary as Figure 4.14-1 depicts. The City of Seattle has estimated a base flood elevation of 23-feet (City of Seattle Datum) at this location. According to the City's GIS database, the proposed Delridge station site adjacent to Longfellow Creek is above the base flood elevation. The station building and any proposed station site improvements would therefore, be located outside of the floodplain. The site is currently a parking lot from which runoff is collected and discharged into the storm system—stormwater does not runoff into the floodplain. The proposed station would manage stormwater in much the same way. Therefore, the hydrology of the floodplain would not change as a result of the Delridge station alternatives.

It is possible that guideway columns beyond the Delridge station footprint might be located in the Longfellow Creek floodplain. The City of Seattle does not allow development to occur within the floodplain if development would cause a one-foot rise in the flood stage during a 100-year flood event. The allowable limits of column encroachment into the floodplain without causing a one-foot rise in the base flood elevation are estimated in Appendix RR - Longfellow Creek Flood Study. The study demonstrates that it should be possible to place the guideway columns outside of this encroachment zone and not adversely impact the Longfellow Creek floodplain.

Riparian Buffer

The Seattle Sensitive Areas Ordinance requires 100-foot riparian corridor buffers for Class A streams. The ordinance specifies that no development shall be permitted within or over the watercourse, unless no other access to a property is available. Permits for crossing over Longfellow Creek would be required by the City of Seattle and WDFW. The City may approve access over the stream as long as it maintains the natural channel and floodway and minimizes disturbance of the buffer. Alternative 6.1 would cross above the stream within the buffer area and may require one or more columns to be located within the stream buffer. Alternatives 6.4 and 6.4(s) would cross over the piped section of Longfellow Creek, but would still be within the creek buffer and may require one or more columns to be placed within the buffer. No other alternatives would require columns within the buffer.

The conceptual station drawings for Delridge 1, 1A, and 2 currently show redevelopment of the entire parcel. Because approximately the western 25 feet of the north parcel is within the riparian buffer area, loss of buffer would occur if any of these Alternatives were constructed as currently depicted. However, if one of these alternatives were to be selected, the station would be designed to minimize impacts to the riparian buffer. Stream buffer impacts would be mitigated as required by the City of Seattle.

Preferred Alternative (Summary of Impacts)

Impacts of stations included in the Preferred Alternative are summarized in Table 4.14-24a. Overall, the stations would increase impervious surface over existing site conditions by approximately 55 percent. Although the Preferred Alternative has the greatest increase in impervious surface area (primarily because the existing Delridge 3 station site is 100 percent pervious), this alternative would have little to no impact to Longfellow Creek, the adjacent wetlands, and their respective buffers. If left unmitigated, the stations could have an adverse impact on the combined sewer system and would increase flows in the last 350-foot section of pipe that conveys Longfellow Creek. However, required mitigation measures would alleviate any potential adverse effects.

Operations Center

Alternatives

The Interbay Operations Center alternative would be located within a completely separated sewer area, with sanitary wastewater and stormwater draining to separate systems. The stormwater from that Operations Center alternative would drain south into Elliott Bay.

The SODO Operations Center alternative would occupy the Lander 4 station site. As described above, this site is also located within a completely separated area. Stormwater from the site flows into Elliott Bay. Elliott Bay, being a marine water body, would not be affected by increased amounts of stormwater for either alternative. Nevertheless, only a small increase (approximately eight percent) in impervious area is expected for the Interbay site. No increase in impervious area is expected for the SODO site (Table 4.14-25). Because the City has included Elliott Bay on the list of designated receiving waters, no quantity-related impacts would be expected.

Preferred Alternative (Summary of Impacts)

The Preferred Alternative for the Operations Center is the Interbay site. The Preferred Alternative would increase impervious surface area by approximately 8 percent, whereas Alternative C-2 would not increase impervious surface above existing conditions.

Guideways

The guideways that Green Line trains would run on are narrow, linear, aerial structures that would not collect and concentrate rainfall in the manner of a typical impervious street, roof, or parking lot. Precipitation falling on the guideway, where constructed over an impervious roadway, would continue to fall onto the roadway; precipitation falling on the guideway, where constructed over vegetated areas, would continue to fall on the vegetated areas, and thus would not impede the flow of water into the ground. Because guideways would not alter the destination of precipitation, the time of concentration, or the volume of runoff from the ground surface below the guideway, the guideways are not considered impervious surface, and therefore would have no impact on the quantity of runoff discharging to the receiving storm system or water bodies.

Bridges

Bridges constructed over the Ship Canal and the Duwamish River would not have water-quantity-related impacts on the receiving water bodies. Precipitation that would be temporarily intercepted by the bridge decks would be discharged to the receiving water at the same rate and volume as it would without a bridge.

Traction Power Substations

Traction power substations would be located along the alignment to supply electricity to the power rail system, which propels the monorail trains. Potential sites have not been identified, but substations could be incorporated into the passenger station designs or may be separate sites. Traction power substation buildings constructed independently of station sites would have site requirements of approximately 5,000 to 7,000 square feet. Portions of the site would likely be paved for parking and access. However, given the small size of the site and building requirements, no significant adverse impacts to drainage systems and receiving water bodies related to changes in stormwater quantity are expected.

Table 4.14-19. Ballard Segment Station Alternatives Drainage Types and Impervious Surface

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 1.1 or 1.1(s) - West Side of 15th							
Crown Hill 1 (West, 85 th)	30,700	30,700	0	0%	Combined	CSO	Ship Canal
Crown Hill 1A (West 85 th)	17,700	17,700	0	0%	Combined	CSO	Ship Canal
NW 65 th 1 (West)	16,000	16,100	+100	+1%	Combined	CSO	Ship Canal
NW 65 th 1A (West)	16,000	16,100	+100	+1%	Combined	CSO	Ship Canal
NW 65 th 1B (West)	16,000	16,100	+100	+1%	Combined	CSO	Ship Canal
NW Market 1 (SW)	40,000	40,000	0	0%	Partially Separated	Storm	Ship Canal
NW Market 3 (NW)	24,700	25,000	+300	+1%	Partially Separated	Storm	Ship Canal
NW Market 3A (NW)	58,900	64,300	+5,400	+9%	Partially Separated	Storm	Ship Canal
TOTAL	105,600	111,100	5,500	5%	-	-	-
Alternative 1.2 - Center of 15th							
Crown Hill 2 (Center)	30,200	43,600	+13,400	+44%	Combined	CSO	Ship Canal
NW 65 th 2 (Center)	17,200	28,900	+11,700	+68%	Combined	CSO	Ship Canal
NW Market 2 (Center)	49,600	49,600	0	0%	Partially Separated	Storm	Ship Canal
TOTAL	97,000	122,100	+25,100	+26%	-	-	-

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-19a. Ballard Segment Preferred Alternative Station Drainage Types and Impervious Surface

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Crown Hill 1A	17,700	17,700	0	0%	Combined	CSO	Ship Canal
NW 65 th 1B (West)	16,000	16,100	+100	+1%	Combined	CSO	Ship Canal
NW Market 3A (NW)	58,900	64,300	+5,400	+9%	Partially Separated	Storm	Ship Canal
TOTAL	92,600	98,100	+5,500	+6%	-	-	-

Table 4.14-20. Interbay/Magnolia Segment Station Alternatives – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 2.1 or 2.1(s) - West Side of 15th/Center of Elliott							
Dravus 1 (16 th)	47,900	50,200	+2,300	5%	Combined	CSO	Puget Sound @ West Point
Dravus 1A (16 th)	29,300	31,400	+2,100	7%	Combined	CSO	Puget Sound @ West Point
Dravus 1B (Barrett)	2,700	24,300	+21,600	800%	Combined	CSO	Puget Sound @ West Point
Howe 1 (West)	11,800	27,500	+15,700	133%	Partially Separated	Storm	Elliott Bay
Howe 1A (Blaine)	27,100	47,400	+20,300	75%	Partially Separated	Storm	Elliott Bay
Elliott & Mercer 1 (Center)	36,200	40,000	+3,800	10%	Combined	CSO	Elliott Bay
Elliott & Mercer 1A (Center)	21,500	22,600	+1,100	5%	Combined	CSO	Elliott Bay
TOTAL	66,000	111,700	+45,700	+69%	-	-	-
Alternative 2.2 - Center of 15th, West Side of Elliott							
Dravus 2 (15 th)	33,200	36,200	+3,000	+9%	Combined	CSO	Puget Sound @ West Point
Howe 2 (Center)	19,500	35,200	+15,700	+81%	Partially Separated	Storm	Elliott Bay
Prospect 3 (West)	50,700	50,800	+100	0%	Combined	CSO	Puget Sound @ West Point
Elliott and Mercer 2 (West)	33,600	33,600	0	0%	Combined	CSO	Elliott Bay
TOTAL	86,300	105,000	+18,700	+22%	-	-	-

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-20a. Interbay/Magnolia Segment Preferred Alternative Stations – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Dravus 1B (Barrett)	2,700	24,300	+21,600	800%	Combined	CSO	Puget Sound @ West Point
Howe 1A (Blaine) FUTURE STATION	27,100	47,400	+20,300	+75%	Partially Separated	Storm	Elliott Bay
Elliott & Mercer 1A (Center)	21,500	22,600	+1,100	+5%	Combined	CSO	Elliott Bay
TOTAL	51,300	94,300	+43,000	+84%	-	-	-

Table 4.14-21. Queen Anne/Seattle Center/Belltown Segment Station Alternatives – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 3.1 - Seattle Center/Republican							
Seattle Center/Queen Anne 1 (North)	45,200	45,200	0	0%	Combined	CSO	Elliott Bay
Seattle Center/ Queen Anne 1A (North)	45,200	45,200	0	0%	Combined	CSO	Elliott Bay
Seattle Center/Fifth & Broad 1	53,100	56,100	+3,000	+6%	Combined	CSO	Lake Union
Seattle Center/Fifth & Broad 1A	32,300	32,300	0	0%	Combined	CSO	Lake Union
Belltown 1 (Center)	20,700	20,700	0	0%	Combined	CSO	Lake Union
Belltown 1A (Center-West)	13,000	13,000	0	0%	Combined	CSO	Lake Union
Belltown 2 (Center-East)	18,000	18,000	0	0%	Combined	CSO	Lake Union
TOTAL	119,000	122,000	+3,000	+3%	-	-	-
Alternative 3.2 – Mercer							
Seattle Center/Queen Anne 1 (North)	45,200	45,200	0	0%	Combined	CSO	Elliott Bay
Seattle Center/Fifth & Broad 2 (Harrison)	33,500	34,200	+700	+2%	Combined	CSO	Lake Union
Belltown 3 (West)	37,200	37,200	0	0%	Combined	CSO	Lake Union

Table 4.14-21. Queen Anne/Seattle Center/Belltown Segment Station Alternatives – Drainage Systems and Impervious Surfaces (continued)

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
TOTAL	115,900	116,600	+700	+1%	-	-	-
Alternative 3.3 – Thomas							
Seattle Center/Queen Anne 2 (South)	49,000	56,200	+7,200	+15%	Partially Separated ^a	CSO	Lake Union
Seattle Center/Fifth & Broad 1	53,100	56,100	+3,000	+6%	Combined	CSO	Lake Union
Belltown 3 (West)	37,200	37,200	0	0%	Combined	CSO	Lake Union
TOTAL	139,300	149,500	+10,200	+7%	-	-	-
Alternative 3.5 - Second/Denny							
Seattle Center/Queen Anne 2 (South)	49,000	56,200	+7,200	+15%	Partially Separated ^a	CSO	Lake Union
Denny 3	21,500	24,100	+2,600	+12%	Combined	CSO	Elliott Bay
Belltown 3 (West)	37,200	37,200	0	0%	Combined	CSO	Lake Union
TOTAL	107,700	117,500	+9,800	+9%	-	-	-

^a Partially separated system through Seattle Center, but drains into combined system east of the Seattle Center.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-21a. Queen Anne/Seattle Center/Belltown Segment Preferred Alternative Stations – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Seattle Center/ Queen Anne 1A (North)	45,200	45,200	0	0%	Combined	CSO	Elliott Bay
Seattle Center/Fifth & Broad 1A	32,300	32,300	0	0%	Combined	CSO	Lake Union
Belltown 1A (Center-West)	13,000	13,000	0	0%	Combined	CSO	Lake Union
TOTAL	90,500	90,500	0	0%	-	-	-

Table 4.14-22. Downtown/Pioneer Square Segment Station Alternatives – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 4.1 - West Side of Second							
Fifth & Stewart 1 (Northwest)	58,000	58,000	0	0%	Combined	CSO	Lake Union
Fifth & Stewart 1A (West)	24,800	24,800	0	0%	Combined	CSO	Lake Union
Fifth & Stewart 2 (Virginia)	28,300	28,300	0	0%	Combined	CSO	Lake Union
Fifth & Stewart 2A (Virginia Center)	16,600	16,600	0	0%	Combined	CSO	Lake Union
Pike 1 (West) A	34,200	34,200	0	0%	Combined	CSO	Elliott Bay
Pike 1 (West) B	33,100	33,100	0	0%	Combined	CSO	Elliott Bay
Madison 1 (West)	32,400	32,400	0	0%	Combined	CSO	Elliott Bay
Yesler 1 (West)	23,100	23,100	0	0%	Combined	CSO	Elliott Bay
TOTAL	147,700	147,700	0	0%	-	-	-
Alternative 4.2 - East Side of Second with Crossover							
Fifth & Stewart 3 (Lenora)	35,200	35,200	0	0%	Combined	CSO	Lake Union
Pike 2 (East)	22,800	22,800	0	0%	Combined	CSO	Elliott Bay
Madison 2 (East)	15,000	17,700	+2,700	+18%	Combined	CSO	Elliott Bay
Yesler 1 (West)	23,100	23,100	0	0%	Combined	CSO	Elliott Bay
TOTAL	96,100	98,800	+2,700	+3%	-	-	-
Alternative 4.3 - Center of Second							
Fifth and Stewart 2 (Virginia)	28,300	28,300	0	0%	Combined	CSO	Lake Union
Pike 3 (Center)	42,200	42,200	0	0%	Combined	CSO	Elliott Bay
Madison 3 (Center)	38,600	38,600	0	0%	Combined	CSO	Elliott Bay
Yesler 2 (Center)	30,400	30,400	0	0%	Combined	CSO	Elliott Bay
TOTAL	139,500	139,500	0	0%	-	-	-

Table 4.14-22. Downtown/Pioneer Square Segment Station Alternatives – Drainage Systems and Impervious Surfaces (continued)

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 4.4 East Center of Second							
Fifth & Stewart 3 (Lenora)	35,200	35,200	0	0%	Combined	CSO	Lake Union
Pike 2A (East Center)	26,300	26,300	0	0%	Combined	CSO	Elliott Bay
Madison 2A (East Center)	18,500	21,200	+2,700	+15%	Combined	CSO	Elliott Bay
Yesler 1 (West)	23,100	23,100	0	0%	Combined	CSO	Elliott Bay
TOTAL	103,100	105,800	+2,700	+3%			

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-22a. Downtown/Pioneer Square Segment Preferred Alternative Stations – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Fifth & Stewart 2A (Virginia Center)	16,600	16,600	0	0%	Combined	CSO	Lake Union
Pike 1 (West) B	33,100	33,100	0	0%	Combined	CSO	Elliott Bay
Madison 1 (West)	32,400	32,400	0	0%	Combined	CSO	Elliott Bay
Yesler 1 (West)	23,100	23,100	0	0%	Combined	CSO	Elliott Bay
TOTAL	105,200	105,200	0	0%	-	-	-

Table 4.14-23. SODO/Chinatown International District/Pioneer Square Segment Station Alternatives – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 5.1 - East Side of Third/Utah							
Weller/King Street 1 (Standard)	46,100	46,100	0	0%	Combined	CSO	Elliott Bay
Safeco Field 1	112,400	112,400	0	0%	Combined	CSO	Elliott Bay
Lander 1 (Northeast)	28,200	28,200	0	0%	Partially Separated	CSO	Elliott Bay
Lander 2 (Southwest)	47,000	47,000	0	0%	Partially Separated	CSO	Elliott Bay
Lander 4 (Utah)	135,000	135,000	0	0%	Completely separated	CSO	Elliott Bay
TOTAL	293,500	293,500	0	0%	-	-	-
Alternative 5.2 - West Side of Third/Utah (or 5.2(s) with addition of Safeco Station)							
Weller/King Street 2 (Event)	66,100	66,100	0	0%	Combined	CSO	Elliott Bay
Safeco Field 1	112,400	112,400	0	0%	Combined	CSO	Elliott Bay
Lander 3 (Diagonal)	53,700	53,700	0	0%	Partially Separated	CSO	Elliott Bay
TOTAL	232,200	232,200	0	0%	-	-	-

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-23a. SODO Segment Preferred Alternative Stations – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Weller/King Street 2 (Event)	66,100	66,100	0	0%	Combined	CSO	Elliott Bay
Safeco Field 1	112,400	112,400	0	0%	Combined	CSO	Elliott Bay
Lander 3 (Diagonal)	53,700	53,700	0	0%	Partially Separated	CSO	Elliott Bay
TOTAL	232,200	232,200	0	0%	-	-	-

Table 4.14-24. West Seattle Segment Station Alternatives – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 6.1 or 6.1(s) – West Seattle I							
Delridge 1 (26 th)	45,200	65,800	+20,600	+46%	Partially Separated	Storm	W. Duwamish Waterway
Avalon 1 (Center)	38,600	44,700	+6,100	+16%	Combined	CSO	W. Duwamish Waterway
Alaska Junction 1 (42 nd /Edmunds)	25,100	26,600	+1,500	+6%	Combined	CSO	W. Duwamish Waterway
Alaska Junction 1A (42 nd /Edmunds)	32,600	34,100	+1,500	+5%	Combined	CSO	W. Duwamish Waterway
Morgan Junction 1 (West)	24,600	24,600	0	0%	Partially Separated	Storm	Puget Sound
Morgan Junction 1A (West)	18,600	18,600	0	0%	Partially Separated	Storm	Puget Sound
TOTAL	133,500	161,700	+28,200	+21%	-	-	-
Alternative 6.2 – West Seattle II							
Delridge 2 (Andover)	31,200	38,800	+7,600	+24%	Partially Separated	Storm	W. Duwamish Waterway
Avalon 2A (35 th)	1,700	16,600	+14,900	+876%	Combined	CSO	W. Duwamish Waterway
Avalon 2B (35 th)	13,600	18,400	+4,800	+35%	Combined	CSO	W. Duwamish Waterway
Alaska Junction 2 (44 th /California)	21,300	23,400	+2,100	+10%	Partially Separated	Storm	Puget Sound
Morgan Junction 2 (Center)	35,900	39,400	+3,500	+10%	Partially Separated	Storm	Puget Sound
TOTAL	90,100	118,200	+28,100	+31%	-	-	-
Alternative 6.3(s) Delridge North Subsegment							
Delridge 3 (Nucor)	0	25,500	+25,500	N/A	Partially Separated	Storm	W. Duwamish Waterway

Table 4.14-24. West Seattle Segment Station Alternatives – Drainage Systems and Impervious Surfaces (continued)

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 6.4 Andover/Yancy Subsegment							
Delridge 1A (26th)	35,600	56,200	+20,600	+58%	Partially Separated	Storm	W. Duwamish Waterway
Alternative 6.5 (Genesee)	5,200	12,000	+6,800	+131%	Combined	CSO	W. Duwamish Waterway
Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Alternative 6.4(s) – Andover/Yancy single beam (no station) Subsegment							
No Station	N/A	N/A	No change	No change	N/A	N/A	N/A
Alternative 6.5 Genesee Subsegment							
Delridge 4 (Genesee)	5,200	12,000	+6,800	+131%	Combined	CSO	W. Duwamish Waterway

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Table 4.14-24a. West Seattle Segment Preferred Alternative Stations – Drainage Systems and Impervious Surfaces

Station	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Delridge 3 (Nucor)	0	25,500	+25,500	N/A	Partially Separated	Storm	W. Duwamish Waterway
Avalon 2B (35 th)	13,600	18,400	+4,800	+35%	Combined	CSO	W. Duwamish Waterway
Alaska Junction 1 (42 nd /Edmunds)	25,100	26,600	+1,500	+6%	Combined	CSO	W. Duwamish Waterway
Morgan Junction 1A (West)	18,600	18,600	0	0%	Partially Separated	Storm	Puget Sound
TOTAL	57,300	89,100	+31,800	+55%	-	-	-

Table 4.14-25. Operations Center Alternatives – Drainage Systems and Impervious Surfaces

Operations Center	Existing Impervious Surface (sf)	New and Replaced Impervious Surface (sf)	Change in Impervious Area (sf)	Percent Change in Impervious	Drainage System	Outfall Type	Receiving Water
Interbay (Alternative C-1)	240,900	260,000	+19,100	+8%	Completely separated	Storm	Elliott Bay
SODO (Lander 4) (Alternative C-2)	135,000	135,000	0	0%	Completely separated	CSO	Elliott Bay

Note: sf = square feet.

Impervious surface area is estimated based on the conservative assumption that sites are 100% impervious with no landscaping.

Impacts From No Action Alternative

The No Action Alternative would not create any new impact on the receiving water bodies or the storm/combined sewer conveyance systems, as changes in impervious surface area resulting from construction of the Green Line would not occur. Therefore, the No Action Alternative would not affect current stormwater runoff patterns. There would not be an opportunity for the mitigation that would occur for new construction consistent with the Seattle Municipal Code.

4.14.5 Mitigation (Operational)

Because Seattle is highly urbanized, most of the station site alternatives being analyzed currently have high percentages of impervious surface area, particularly through the Queen Anne/Seattle Center/Belltown, Downtown/Pioneer Square, and SODO/Chinatown International District/Pioneer Square Segments. In these areas, the proposed alternatives would not be expected to have significant adverse impacts associated with replacing the existing land uses with stations, even without mitigation. However, the City's drainage regulations require redevelopment projects to provide flow control mitigation as if the site were undeveloped, unless an exemption applies. The purpose of the regulation is to improve stormwater conditions in highly developed watersheds that did not have stormwater regulations meeting current standards in effect at the time of construction. The *Flow Control Technical Requirements Manual* for mitigation of new and replaced impervious surfaces includes:

- All new development that would create or replace more than 2,000 square feet of impervious surface is required to implement flow control.
- This requirement would apply to all proposed station and Operations Center alternatives, as well as all traction power substations.
- Developed discharge rates during a 25-year, 24-hour storm event shall not exceed 0.2 cubic feet per second (cfs) per acre.
- This requirement was used to estimate the volume of a detention facility that could be required for station and Operations Center alternatives, for purposes of comparing flow control mitigation between the alternatives. It was also used to estimate the volume of a detention facility for a typical traction power substation.
- Projects located in areas where stormwater runoff drains directly to a designated receiving water may be exempt from detention requirements, where no capacity problems are anticipated in the conveyance system.
- This may be used at the discretion of the governing agencies to exempt certain qualifying stations or the Operations Center from the requirement to implement on-site flow control.
- Projects that add or replace more than 5,000 square feet of impervious surface are subject to additional detention requirements if they drain to a Class A or Class B riparian corridor. Stormwater discharge shall be limited to 0.5 cfs per acre during the 100-year, 24-hour storm event. This requirement would apply to both of the Delridge station alternatives, since stormwater would likely drain to Longfellow Creek, which is a Class A water body.
- Maintenance, repair, or installation of underground or overhead utility facilities, such as, but not limited to, pipes, conduits, and vaults are only required to implement construction stormwater controls.

As mentioned in the impacts section, designated receiving waters that receive stormwater from the project area include the Duwamish River, Puget Sound, Lake Union, and the Lake Washington Ship Canal.

Contaminated soils may be encountered at various sites during the construction of stations, Operations Center, or traction power substations. Temporary sediment and erosion control best management practices would be used to prevent contaminated soils from being washed off-site during soil excavation and removal activities. Refer to Section 4.12, Environmental Health, for further discussion of removal and disposal of contaminated soils.

Stations

Mitigation for potential stormwater quantity impacts would most likely be provided through the use of detention facilities designed in accordance with the *Seattle Flow Control Technical Requirements Manual*. Estimates of required detention volumes for each station alternative are provided in Tables 4.14-26 through 4.14-31 for purposes of comparison. Final volumes would be determined during site design and permitting. Detention volumes were estimated based on the amount of new and replaced impervious surface anticipated to be constructed on the site, including the associated guideway overhangs. All station alternatives being analyzed are assumed to be 100 percent impervious. This would result in a conservatively high detention volume estimate.

Table 4.14-26. Ballard Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 1.1 or 1.1(s) - West Side of 15th		
Crown Hill 1 (West, 85 th)	30,700 (0.70)	2,200
Crown Hill 1A	17,700 (0.41)	1,300
NW 65 th 1 (West)	16,100 (0.37)	1,100
NW 65 th 1A (West)	16,100 (0.37)	1,100
NW 65 th 1B (West)	16,100 (0.37)	1,100
NW Market 1 (SW)	40,000 (0.92)	2,800
NW Market 3 (NW)	25,000 (0.57)	1,800
NW Market 3A	65,000 (1.49)	4,600
TOTAL	111,800 (2.57)	7,900
Alternative 1.2 - Center of 15th		
Crown Hill 2 (Center)	43,600 (1.00)	3,100
NW 65 th 2 (Center)	28,900 (0.66)	2,100
NW Market 2 (Center)	49,600 (1.14)	3,500
TOTAL	122,100 (2.80)	8,700

Notes: sf = square feet

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Providing flow control measures would mitigate potential increases in runoff resulting from the Green Line by reducing the peak runoff discharge rates from stations. By reducing peak flows entering combined systems, the sewer pipes are less likely to exceed their capacity due to incremental increases in impervious surface area; therefore, CSO occurrences would not likely increase as a result of the Green Line. By reducing peak flows entering streams, high flow velocities and flooding events would not likely increase as a result of the project.

Application of stormwater detention facilities where required at station sites could provide a water quantity benefit because most existing sites were constructed prior to flow control regulations and likely do not currently have detention facilities.

Segment 1 - Ballard Segment

Alternatives

Alternative 1.1 or 1.1(s) would add approximately 2.57 acres of new and replaced impervious surface with a combined total of approximately 7,900 cubic feet of detention volume. Alternative 1.2 would add approximately 2.8 acres of new and replaced impervious surface with an estimated combined total of 8,700 cubic feet of detention.

Preferred Alternative (Summary of Mitigation)

Ballard segment stations included in the Preferred Alternative would add approximately 2.27 acres of new and replaced impervious surface and may require up to 7,000 cubic feet of detention volume (Table 4.14-26a). Comparatively, Alternatives 1.1 and 1.2 may require up to 7,900 and 8,700 cubic feet of detention volume to mitigate new and replace impervious surfaces as described above.

Table 4.14-26a. Ballard Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Crown Hill 1A	17,700 (0.41)	1,300
NW 65 th 1B (West)	16,100 (0.37)	1,100
NW Market 3A	65,000 (1.49)	4,600
TOTAL	98,800 (2.27)	7,000

Segment 2 – Interbay/Magnolia Segment

Alternatives

Alternative 2.1 or 2.1(s) would add approximately 2.56 acres of new and replaced impervious surface with an estimated detention volume of 7,900 cubic feet. Alternative 2.2 would add approximately 2.41 acres of new and replaced impervious surface with an estimated total detention volume of approximately 7,500 cubic feet.

Table 4.14-27. Interbay/Magnolia Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 2.1 or 2.1(s) - West Side of 15th/Center of Elliott		
Dravus 1 (16 th)	50,200 (1.15)	3,600
Dravus 1A (16 th)	31,400 (0.72)	2,200
Dravus 1B (Barrett)	24,300 (0.56)	1,700
Howe 1 (West)	27,500 (0.63)	2,000
Howe 1A (Blaine)- FUTURE STATION	47,400 (1.09)	3,400

Table 4.14-27. Interbay/Magnolia Segment Station Site Detention Volumes (continued)

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Elliott and Mercer 1 (Center)	40,000 (0.92)	2,800
Elliott and Mercer 1A (Center)	22,600 (0.52)	1,600
TOTAL	111,700 (2.56)	7,900
Alternative 2.2 - Center of 15th/West Side of Elliott		
Dravus 2 (15 th)	36,200 (0.83)	2,600
Howe 2 (Center)	35,200 (0.81)	2,500
Prospect 3 (West)	50,800 (1.17)	3,600
Elliott and Mercer 2 (West)	33,600 (0.77)	2,400
TOTAL	105,000 (2.41)	7,500

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Mitigation)

Interbay/Magnolia segment stations included in the Preferred Alternative would add approximately 2.16 acres of new and replaced impervious surface and may require up to 6,700 cubic feet of detention volume (Table 4.14-27a). Comparatively, Alternatives 2.1 and 2.2 may require approximately 7,900 and 7,500 cubic feet of detention volume respectively.

Table 4.14-27a. Interbay/Magnolia Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Dravus 1B (Barrett)	24,300 (0.56)	1,700
Howe 1A (Blaine) - FUTURE STATION	47,400 (1.09)	3,400
Elliott & Mercer 1A (Center)	22,600 (0.52)	1,600
TOTAL	94,300 (2.16)	6,700

Segment 3 - Queen Anne/Seattle Center/Belltown Segment

Alternatives

Alternatives 3.1, 3.2, and 3.5 would each add approximately 2.7 to 2.8 acres of new and replaced impervious surface area. The total detention volume would range from 8,200 to 8,700 cubic feet. Alternative 3.3 would add the largest amount of new and replaced impervious surface, approximately 3.4 acres with an estimated combined total of 10,600 cubic feet of detention.

Table 4.14-28. Seattle Center Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 3.1 - Seattle Center/Republican		
Seattle Center/Queen Anne 1 (North)	45,200 (1.04)	3,200
Seattle Center/Queen Anne 1A (North)	45,200 (1.04)	3,200

Table 4.14-28. Seattle Center Segment Station Site Detention Volumes (continued)

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Seattle Center/Fifth & Broad 1	56,100 (1.29)	4,000
Seattle Center/Fifth & Broad 1A	32,300 (0.74)	2,300
Belltown 1 (Center)	20,700 (0.48)	1,500
Belltown 1A (Center-West)	13,000 (0.30)	900
Belltown 2 (Center-East)	18,000 (0.41)	1,300
TOTAL	122,000 (2.80)	8,700
Alternative 3.2 – Mercer		
Seattle Center/Queen Anne 1 (North)	45,200 (1.04)	3,200
Seattle Center/Fifth & Broad 2 (Harrison)	34,200 (0.79)	2,400
Belltown 3 (West)	37,200 (0.85)	2,600
TOTAL	116,600 (2.68)	8,200
Alternative 3.3 – Thomas		
Seattle Center/Queen Anne 2 (South)	56,200 (1.29)	4,000
Seattle Center/Fifth & Broad 1	56,100 (1.29)	4,000
Belltown 3 (West)	37,200 (0.85)	2,600
TOTAL	149,500 (3.43)	10,600
Alternative 3.5 - Second/Denny		
Seattle Center/Queen Anne 2 (South)	56,200 (1.29)	4,000
Denny 3	24,100 (0.55)	1,700
Belltown 3 (West)	37,200 (0.85)	2,600
TOTAL	117,500 (2.70)	8,300

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Mitigation)

Queen Anne/Seattle Center/Belltown segment stations included in the Preferred Alternative would add approximately 2.08 acres of new and replaced impervious surface and may require up to 6,400 cubic feet of detention volume (Table 4.14-28a). Comparatively, detention requirements for the other alternatives would likely be greater, with detention volumes for Alternatives 3.1, 3.2, 3.3, and 3.5 estimated at 8,700, 8,200, 10,600, and 8,300 cubic feet respectively.

Table 4.14-28a. Seattle Center Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Seattle Center/Queen Anne 1A (North)	45,200 (1.04)	3,200
Seattle Center/Fifth & Broad 1A	32,300 (0.74)	2,300
Belltown 1A (Center-West)	13,000 (0.30)	900
TOTAL	90,500 (2.08)	6,400

Segment 4 – Downtown/Pioneer Square Segment

Alternatives

Alternative 4.2 would add the least amount of new and replaced impervious surface—approximately 2.3 acres with an estimated detention volume of approximately 7,000 cubic feet. Alternative 4.4 would add slightly more new and replaced impervious surface – 2.43 acres with 7,500 cubic feet of detention estimated. Alternatives 4.1 and 4.3 would each add approximately 3.2 to 3.4 acres of new and replaced impervious surface with detention volumes estimated at 9,900 to 10,400 cubic feet.

Table 4.14-29. Downtown/Pioneer Square Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 4.1 - West Side of Second		
Fifth & Stewart 1 (Northwest)	58,000 (1.33)	4,100
Fifth & Stewart 1A (West)	24,800 (0.57)	1,800
Fifth & Stewart 2 (Virginia)	28,300 (0.65)	2,000
Fifth & Stewart 2A (Virginia Center)	16,600 (0.38)	1,200
Pike 1 (West) A	34,200 (0.79)	2,400
Pike 1 (West) B	33,100 (0.76)	2,300
Madison 1 (West)	32,400 (0.74)	2,300
Yesler 1 (West)	23,100 (0.53)	1,600
TOTAL	147,700 (3.39)	10,400
Alternative 4.2 – East Side of Second with Crossover		
Fifth & Stewart 3 (Lenora)	35,200 (0.81)	2,500
Pike 2 (East)	22,800 (0.52)	1,600
Madison 2 (East)	17,700 (0.41)	1,300
Yesler 1 (West)	23,100 (0.53)	1,600
TOTAL	98,800 (2.27)	7,000
Alternative 4.3 - Center of Second		
Fifth & Stewart 2 (Virginia)	28,300 (0.65)	2,000
Pike 3 (Center)	42,200 (0.97)	3,000
Madison 3 (Center)	38,600 (0.89)	2,700
Yesler 2 (Center)	30,400 (0.70)	2,200
TOTAL	139,500 (3.20)	9,900
Alternative 4.4 – East Center of Second		
Fifth & Stewart 3 (Lenora)	35,200 (0.81)	2,500
Pike 2A (East Center)	26,300 (0.60)	1,900
Madison 2A (East Center)	21,200 (0.49)	1,500
Yesler 1 (West)	23,100 (0.53)	1,600
TOTAL	105,800 (2.43)	7,500

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Mitigation)

Downtown/Pioneer Square segment stations included in the Preferred Alternative would add approximately 2.42 acres of new and replaced impervious surface and may require up to 7,400 cubic feet of detention volume (Table 4.14-29a). The estimated detention volume for the Preferred Alternative falls in the lower end of the range of detention volumes that may be required for the other alternatives, which range from 7,000 to 10,400 cubic feet as described in the section above.

Table 4.14-29a. Downtown/Pioneer Square Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Fifth & Stewart 2A (Virginia Center)	16,600 (0.38)	1,200
Pike 1 (West) B	33,100 (0.76)	2,300
Madison 1 (West)	32,400 (0.74)	2,300
Yesler 1 (West)	23,100 (0.53)	1,600
TOTAL	105,200 (2.42)	7,400

Segment 5 – SODO/Chinatown International District/Pioneer Square Segment

Alternatives

Alternative 5.1 would add a maximum of 6.74 acres of new and replaced impervious surface and may require nearly 21,000 cubic feet of detention volume. This alternative adds more new and replaced impervious surface because the Lander 4 (Utah) site doubles as a potential Operations Center site and is therefore, large compared to the other Lander sites. Alternative 5.2 would add approximately 5.33 acres of new and replaced impervious surface. If detention were required at all of the sites, the estimated combined volume would be approximately 16,500 cubic feet. For mitigation of Alternative 5.2(s) refer to the Preferred Alternative section below.

Table 4.14-30. SODO/Chinatown International District/Pioneer Square Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 5.1 - East Side of Third/Utah		
Weller/King Street 1 (Standard)	46,100 (1.06)	3,300
Safeco Field 1	112,400 (2.58)	8,000
Lander 1 (Northeast)	28,200 (0.65)	2,000
Lander 2 (Southwest)	47,000 (1.08)	3,300
Lander 4 (Utah)	135,000 (3.10)	9,600
TOTAL	293,500 (6.74)	20,900
Alternative 5.2 - West Side of Third/Utah		
Weller/King Street 2 (Event)	66,100 (1.52)	4,700
Safeco Field 1	112,400 (2.58)	8,000
Lander 3 (Diagonal)	53,700 (1.23)	3,800
TOTAL	232,200 (5.33)	16,500

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Mitigation)

SODO/Chinatown International District/Pioneer Square Segment stations included in the Preferred Alternative would add approximately 5.33 acres of new and replaced impervious surface and may require up to 16,500 cubic feet of detention volume (Table 4.14-29a). Alternative 5.2, having the same station alternatives, would require the same mitigation. Alternative 5.1 may require a greater detention volume if the Lander 4 station were selected (20,900 cubic feet).

Table 4.14-30a. SODO/Chinatown International District/Pioneer Square Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 5.2(s) - West Side of Third/Utah with single beam		
Weller/King Street 2 (Event)	66,100 (1.52)	4,700
Safeco Field 1	112,400 (2.58)	8,000
Lander 3 (Diagonal)	53,700 (1.23)	3,800
TOTAL	232,200 (5.33)	16,500

Segment 6 - West Seattle Segment

Alternatives

Total detention volumes for Alternative 6.2 may be slightly less than for Alternative 6.1 because Alternative 6.2 would add approximately 1-acre less new and replaced impervious surface. Detention volumes for Delridge 1, 1A, and 2 were each estimated based on the City of Seattle requirement to detain the 100-year, 24-hour storm for sites draining to Class A or B riparian corridor.

Table 4.14-31. West Seattle Segment Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 6.1 or 6.1(s) - West Seattle I		
Delridge 1 (26 th)	65,800 (1.51)	3,400
Avalon 1 (Center)	44,700 (1.03)	3,200
Alaska Junction 1 (42 nd /Edmunds)	26,600 (0.61)	1,900
Alaska Junction 1A (42 nd /Edmunds)	34,100 (0.78)	2,400
Morgan Junction 1 (West)	24,600 (0.56)	1,700
Morgan Junction 1A (West)	18,600 (0.43)	1,300
TOTAL	161,700 (3.71)	10,200
Alternative 6.2 – West Seattle II		
Delridge 2 (Andover)	38,800 (0.89)	2,000
Avalon 2A (35 th)	16,600 (0.38)	1,200
Avalon 2B (35 th)	18,400 (0.42)	1,300
Alaska Junction 2 (44 th /California)	23,400 (0.54)	1,700
Morgan Junction 2 (Center)	39,400 (0.90)	2,800
TOTAL	118,200 (2.71)	7,700

Table 4.14-31. West Seattle Segment Station Site Detention Volumes (continued)

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Alternative 6.3(s) – Delridge North Subsegment		
Delridge 3 (Nucor)	25,500 (0.59)	1,800
Alternative 6.4 –Andover/Yancy Subsegment		
Delridge 1A (Delridge/Andover)	56,200 (1.29)	2,900
Alternative 6.5 –Genesee Subsegment		
Delridge 4 (Genesee)	12,000 (0.28)	900

Note: sf = square feet.

Only bolded numbers are included in total as some alignment alternatives also contain station alternatives.

Preferred Alternative (Summary of Mitigation)

West Seattle segment stations included in the Preferred Alternative would add approximately 2.05 acres of new and replaced impervious surface and may require up to 6,300 cubic feet of detention volume (Table 4.14-29a). The estimated detention volume for the Preferred Alternative is less than the volumes estimated for Alternatives 6.1 and 6.2, which are 10,200 and 7,700 respectively.

Table 4.14-31a. West Seattle Segment Preferred Alternative Station Site Detention Volumes

Station	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Delridge 3 (Nucor)	25,500 (0.59)	1,800
Avalon 2B (35 th)	18,400 (0.42)	1,300
Alaska Junction 1 (42 nd /Edmunds)	26,600 (0.61)	1,900
Morgan Junction 1A (West)	18,600 (1.43)	1,300
TOTAL	89,100 (2.05)	6,300

Operations Center

Alternatives

The Operations Center alternatives are hydrologically similar to station sites, although typically larger. The sites would be governed by the same flow control requirements as the station sites. The Operations Center alternatives are both assumed to be 100 percent impervious for the redeveloped condition. Both alternatives would be located in completely separated sewer areas and would each discharge to a designated receiving water. Therefore, no flow control mitigation is expected unless drainage capacity issues become apparent during final design. Estimated detention volumes are provided in Table 4.14-32 for purposes of comparison.

Table 4.14-32. Operations Center Site Detention Volumes

Operations Center	New and Replaced Impervious Surface in sf (acres)	Detention Volume (cubic feet)
Interbay (Alternative C-1)	260,000 (5.97)	18,400
SODO (Lander 4) (Alternative C-2)	135,000 (3.10)	9,600

Note: sf = square feet.

Preferred Alternative (Summary of Mitigation)

The Preferred Alternative for the Operations Center is the Interbay site (Alternative C-1). This alternative would add approximately 5.97 acres of new and replaced impervious surface and may require up to 18,400 cubic feet of detention volume. Comparatively, Alternative C-2 may require approximately 9,600 cubic feet of detention volume.

Guideways

From the perspective of the Seattle Drainage Code, the guideway and columns may be considered an overhead utility, similar to elevated walkways, and not an impervious surface. As such, the guideway and columns would be exempt from flow control requirements. The exemption as stated in Seattle Municipal Code (SMC) 22.802.016A reads, "Exception: Maintenance, repair, or installation of underground or overhead utility facilities, such as, but not limited to, pipes, conduits and vaults, is not required to comply with the provisions of this section except subsection B7." Subsection B7 refers to construction stormwater control and does not apply to operational impacts. Functionally, the guideway and columns would not affect the rate or quantity of runoff entering a receiving waterbody, and therefore, no adverse impacts are anticipated and no mitigation is proposed for the Green Line's guideways and columns.

Bridges

Because bridges do not affect the rates or quantity of runoff entering receiving water, no flow control mitigation is anticipated.

Traction Power Substations

The traction power substation sites would be subject to flow control requirements under Seattle's Drainage Code. A typical 7,000-square-foot site would require a detention volume of approximately 500 cubic feet, assuming the site would be 100 percent impervious (conservative estimate).

Mitigation for No Action Alternative

No mitigation would be anticipated for the No Action Alternative because no new impacts would be expected. The affected environment would not benefit from mitigation measures such as stormwater flow control and reduced likelihood of CSOs associated with the Green Line project.

Potential station, Operations Center, and traction power substation sites that would discharge stormwater to combined sewers and non-designated receiving water bodies would apply flow control measures to the redeveloped site. Where existing sites are not currently equipped with detention facilities, applying flow control to detain runoff from new and replaced impervious surface created by redevelopment could benefit the combined sewer by reducing the frequency and duration of high flows into the system, thereby reducing the likelihood of CSO occurrences. Flow control applied to sensitive water bodies (Longfellow Creek) could benefit by reduced frequency and duration of high flows, thereby potentially easing fish migration and flooding. These benefits may not occur if the Green Line is not constructed.

4.14.6 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts are expected as a result of this project.

4.15 PLANTS AND ANIMALS

This section analyzes the natural habitat characteristics and major species present along the Green Line alternative alignments. The analysis first identifies habitat types and species of fish, birds, animals, and vegetation potentially affected by one or more of the Green Line alternatives. It also identifies Endangered Species Act (ESA) listed species as well as Essential Fish Habitat (EFH) in the project area. The analysis next describes changes to the habitat and biota that could occur with the various alternatives, differences in impacts of various alignment alternatives, and how these impacts could either be avoided or minimized. Finally, mitigation options are identified where appropriate, along with significant unavoidable adverse impacts. This section focuses on operational impacts; construction impacts are analyzed in Section 4.17.

Existing conditions and impacts to street trees along the Green Line alternative alignments are analyzed in Section 4.5, Visual Quality and Aesthetic Resources, Section 4.10, Parks and Recreation, and Appendix W, Tree Survey. The impacts on birds from street tree removal are also analyzed in this section. The analysis of existing water quantity and quality and impacts is presented in Section 4.14, Water. This analysis indicates that there would be no significant adverse impacts to water quality or quantity and no significant adverse impacts to fish and aquatic habitat are anticipated in either the Lake Washington Ship Canal or, the Duwamish River with any of the Green Line alternatives.

Comments on the potential impacts on plants and animals received from the public and agencies during the scoping process focused primarily on the potential loss of habitats. Areas mentioned included the Ship Canal, Seattle Center, Duwamish River, Pigeon Point, and Longfellow Creek. Concern was expressed for potential impacts to both terrestrial and aquatic species, including potential impacts to animals during project construction. In response to these comments, SMP has refined the alternatives and potential construction methods to reduce potential impacts to habitats and species in the action area.

4.15.1 Affected Environment

This section describes the habitat features along the Green Line route that would potentially be affected by one or more of the alternatives. The area surrounding the Green Line alternative alignments is already intensely developed with urban residential, commercial, and industrial uses. The fish, wildlife, and vegetation resources existing along the Green Line alternative alignments from north Ballard through the Seattle City Center to West Seattle are primarily restricted to several specific locations where natural habitat characteristics remain.

Habitats with characteristics supporting some fish, wildlife, and vegetation species are present at a number of areas along the Green Line alternative alignments:

- **Lake Washington Ship Canal.** The Ship Canal contains aquatic habitat and biota at the locations where the alternative crossings for the Green Line are proposed.
- **Queen Anne Greenbelt/Kinnear Park.** The approximately 15-acre Southwest Queen Anne Greenbelt and the two-tiered 14-acre Kinnear Park are located on the southwest slope of Queen Anne Hill above 15th Avenue W and Elliott Avenue W.
- **Duwamish River.** The location proposed for alternative crossings of the Green Line over the Duwamish River also contains aquatic habitat and biota.
- **Longfellow Creek.** Riparian habitat is present along the downstream end of the open channel portion of Longfellow Creek in the 5.65-acre open greenbelt just south of SW Andover Street.
- **Pigeon Point Greenbelt.** Terrestrial habitat (wildlife and vegetation) exists in the Pigeon Point portion of the 181.6-acre West Duwamish Greenbelt southwest of the Duwamish River crossing.

- **Street Trees and Vegetation.** Additional planted vegetation are found in the planted areas along the alignment alternatives, with particular concentrations in portions of the Seattle Center, W Harrison Street, and some streets in West Seattle.
- **Wetlands.** There are two small wetlands located southwest of the SW Andover Street/26th Avenue SW intersection, west of Longfellow Creek.

Within each area described above, the habitat and biota potentially affected by the different Green Line alternatives are identical or nearly identical. The few instances where impacts to the habitats and biota vary with some of the alternatives are identified in the discussion below. These include alternatives for the Ballard Crossing (Segment 1) and the Pigeon Point Greenbelt/Longfellow Creek areas (Segment 6).

4.15.1.1 Fish and Aquatic Habitat

Fish and supporting habitat are present at four locations along the Green Line alternative alignments: the Lake Washington Ship Canal, the Duwamish River (East and West Waterways) crossings, and Longfellow Creek. This section describes those areas and the types of fish and habitat that are found there.

The Ship Canal is an important route for juvenile salmon migrating from the Lake Washington watershed toward Elliott Bay and the Pacific Ocean. In particular, the Ship Canal in the area of the Ballard Bridge currently provides highly modified habitat for juvenile salmon (including Chinook salmon [*Oncorhynchus tshawytscha*], listed as threatened under the ESA). The Ship Canal is also a migratory corridor for returning adult Chinook and other salmon returning to the Lake Washington System.

The Duwamish River is also an important migration and rearing corridor for all juvenile Chinook and other salmon produced within the Green-Duwamish River watershed. The East and West Waterways of the Duwamish River, where the Green Line crossings would occur, provide estuarine habitat supporting a variety of fish and other aquatic species.

Longfellow Creek is a small urban stream that provides spawning and rearing habitat for several salmonid species (coho salmon [*O. kisutch*], chum salmon [*O. keta*], and cutthroat trout [*O. clarki*]).

Segments 1 and 2: Ballard and Interbay/Magnolia Segments

Lake Washington Ship Canal. Four alternative alignments are being considered for the Green Line's crossing of the Ship Canal (called the Ballard Crossing). Alternatives 1.1.1 (West Bridge), 1.1.1(s) (West Bridge with single beam), and 1.1.2 (Far West Bridge) would be located between 40 and 200 feet west of the existing Ballard Bridge (see Chapter 3 for maps and a more detailed description). Alternative 1.2 (East Bridge) would be located approximately 100 feet east of the Ballard Bridge. Each of the nine to eleven support columns will be approximately 12 feet in diameter, thereby covering up to approximately 1,200 square feet of bottom area. As described below, the footings for each column will be up to approximately 48 by 48 feet square, and will be constructed below the mud line and covered with clean fill up to the mud line.

The physical characteristics of the Ship Canal are slightly different at each of the alternative locations for the Ballard Crossing. The Ship Canal is substantially wider on the west side of the Ballard Bridge than it is on the east side due to the Port of Seattle's Salmon Bay Terminal, which is located on the southern shoreline of the Ship Canal. On the west side of the Ballard Bridge at the Ballard Crossing location, the south side of the Ship Canal is occupied by a small boat repair facility. Shipways of this facility extend from the shoreline out to near the edge of the navigation channel, parallel with the Ballard Bridge. Small

boat moorage and launch facilities are located on the north shore of the Ship Canal adjacent to the west side of the existing bridge.

Aquatic habitat along the Green Line's alternative proposed crossing locations of the Lake Washington Ship Canal near the site of the existing Ballard Bridge includes the physical and chemical characteristics of the aquatic environment. The shorelines along both sides of the Ship Canal at the Ballard Crossing location have been dredged and constructed with hardened materials to maintain steep slopes at the shorelines. The sediment is fine grained (mud and silt) with elevated levels of metals and organic contaminants. Little to no riparian or aquatic vegetation is present at the Green Line crossing alternative locations due to the intense commercial uses of the shorelines.

The Ship Canal is a constructed waterway with a dredged channel that lacks naturally occurring shallow-water habitat typically preferred by juvenile migrating salmonids. The hardened shorelines along the Ship Canal in the crossing area do provide man-made shallow-water habitat for young salmon during their downstream migration period. Generally, these man-made shorelines are characterized by vertical slopes and hard substrates (wood, concrete, stone) at the shoreline with water depths of six to ten feet at the base of the vertical slopes. The Ship Canal diverts drainage from Lake Washington that historically flowed through the Black River to the Duwamish River and Elliott Bay. The physical characteristics of the constructed channel together with the chemical characteristics of the sediment and water provide habitat for the aquatic species residing in or migrating through the Ship Canal. See Section 4.10, Water, for information on sediments in the area of the alternative crossings. The Ship Canal has a dredged navigation channel about 35 feet deep with adjacent shallows about 10 to 24 feet deep (based on bathymetry maps). The width of these shallow areas varies from 100 feet to about 1,200 feet at various locations near the Ballard Bridge where the Green Line alternatives would cross the canal.

The Ship Canal has sediment composed of silty sand with the ratio of silt to sand varying by specific location (Serdar et al. 2000). Sediment in the Ship Canal near the Ballard crossing locations has been contaminated by industrial activities that have occurred along the shorelines and in shoreline waters for approximately 85 years. Information on the nature and degree of contaminants in the existing sediment is provided in Section 4.14, Water. Juvenile salmonids migrate relatively quickly through this area based on recent tagging information (2004 Greater Lake Washington Chinook Workshop, February 2, 2004). The one to several days young salmon spend in the Ship Canal may allow them to acquire low levels of contaminants transferred from sediment through the food web. However, during their migration the young salmon are feeding primarily on zooplankton (*Daphnia* sp.), which probably do not acquire substantial levels of contaminants from the sediment (2004 Greater Lake Washington Chinook Workshop, February 2, 2004). The ubiquitous contaminants in the sediment are likely transferred to benthic invertebrates such as cray fish, which are consumed by fishes such as, smallmouth bass and northern pikeminnow.

See Section 4.12, Environmental Health, for information on uplands adjacent to crossing locations. Little to no riparian or aquatic vegetation is present at the Green Line crossing alternative locations due to the intense commercial uses of the shorelines. Eurasian milfoil in some of the shallower areas adjacent to the navigation channel is the only identified aquatic vegetation identified in the potential crossing area.

The Lake Washington Ship Canal is the migratory route of all salmon produced within the Lake Washington watershed. Juvenile salmonids present at the Green Line bridge site include subyearling Chinook, chum, and pink salmon that migrate downstream through the Ship Canal on their way to Puget Sound. Yearling sockeye, coho and steelhead salmon also migrate to Puget Sound through the Ship Canal. Subadult and adult bull trout and cutthroat trout also migrate in both directions through the Ship Canal. Adults of each salmon species migrate upstream through the Ship Canal to Lake Washington tributaries.

Many fish species inhabit Lake Washington and are therefore likely to occur at least occasionally at the Ship Canal crossing locations. The more common of these species are listed in Table 4.15-1. Many other introduced (exotic) species also occur in Lake Washington, such as tench and goldfish.

Table 4.15-1. Fish Species Common in Lake Washington Potentially Occurring in the Vicinity of the Ship Canal Crossing Alternative Locations

Common Name	Scientific Name
river lamprey	<i>Lampetra ayresi</i>
bull trout	<i>Salvelinus confluentus</i>
cutthroat trout	<i>Oncorhynchus clarki</i>
rainbow trout (<i>steelhead</i>)	<i>Oncorhynchus mykiss</i>
Chinook salmon	<i>Oncorhynchus tshawytscha</i>
coho salmon	<i>Oncorhynchus kisutch</i>
sockeye salmon	<i>Oncorhynchus nerka</i>
bass, largemouth	<i>Micropterus salmoides</i>
bass, smallmouth	<i>Micropterus dolomieu</i>
black crappie	<i>Pomoxis nigromaculatus</i>
brown bullhead	<i>Ictalurus nebulosus</i>
longfin smelt	<i>Spirinchus thaleichthys</i>
Carp	<i>Cyprinus carpio</i>
Northern pikeminnow	<i>Mylocheilus caurinus</i>
largescale sucker	<i>Catostomus macrocheilus</i>
peamouth chub	<i>Mylocheilus caurinus</i>
pelagic sculpin	<i>Cottus aleuticus</i>
prickly sculpin	<i>Cottus asper</i>
threespine stickleback	<i>Gasterosteus aculeatus</i>
yellow perch	<i>Perca flavescens</i>

Juvenile Chinook salmon tend to use shallow-water shoreline habitats of various characteristics during their rearing migration to the ocean (Bostick 1955; Salo 1969; Williams et al. 1975; Weitkamp and Campbell 1980; Weitkamp and Schadt 1982; Meyer et al. 1980; Warner and Fritz 1995; Tabor et al. 2002). Juveniles of these species appear to prefer relatively protected shorelines with gradual slopes and depths of less than about 6 feet. However, they are also found along hard, steep-to-vertical substrates that are either natural or man-made. In the Ship Canal, essentially no natural habitat remains, at least not near the Green Line crossing alternatives (Toft et al. 2003). The Ship Canal is a man-made waterway with a dredged channel. The shorelines generally are steep with concrete, wood, or steel bulkheads, rock riprap, or are covered by low docks (generally less than 6 feet above the water).

Yearling coho, sockeye, and steelhead also migrate out through the Ship Canal but appear to be less shoreline-oriented than the subyearling migrants. The substantially larger yearlings are commonly found in the near-surface water well away from the shoreline, although no specific information is available for the Ship Canal. The channel profile characteristics, straight shorelines, absence of off-channel habitat, and steep, hardened shallow-water areas provide little refugia or foraging habitat for juvenile salmonids migrating through the Ship Canal at the Green Line crossing location. Anadromous game fish that

migrate through the Ship Canal regularly or occasionally include steelhead (*O. mykiss*), sea-run cutthroat trout (*O. clarki*), Dolly Varden (*Salvelinus malma*), and bull trout (*S. confluentus*).

Smallmouth bass in Lake Washington and the Ship Canal prey on juvenile Chinook and other salmon during their rearing migration through the lake and canal. Smallmouth bass frequently associate with structures such as piles and columns that occur along the shorelines where the young salmon migrate. This could include the existing Ballard Bridge support columns along the edge of the dredged channel and adjacent shallow water. This predation appears to be a limiting factor in the survival of young salmonids (Weitkamp and Ruggerone 2000).

The Lake Washington Ship Canal and the Duwamish River, discussed below, are areas where members of the Muckleshoot Tribe and other Tribes harvest adult salmon pursuant to judicially recognized Treaty rights, as interpreted by the “Boldt Decision” of 1974. In those and subsequent decisions, the court determined that Indian Treaty Tribes have rights to 50 percent of harvestable salmon and have the right to co-manage salmon fisheries within Washington State. In 1854 and 1855 many Indian Tribes in the Pacific Northwest entered into treaties with the United States wherein they reserved the right to fish, hunt, and gather in areas off their reservations. These reserved treaty rights are the “supreme law of the land” and where in conflict with state law are preemptive. Judicial decisions have affirmed that treaty Indian Tribes have a right to harvest fish free of state interference, subject to conservation principals; to co-manage the fishery resource with the state; and to harvest up to 50 percent of the harvestable fish. See United States v. Washington, 384 F. Supp. 312 (WD Wn. 1974), aff’d 520 F.2d 676 (9th Cir. 1975); Washington v. Washington State Commercial Passenger Fishing Vessel Ass’n., 433 U.S. 658 (1979).

The project area may fall within certain of the “usual and accustomed” fishing areas of several Federally recognized Indian Tribes, including the Muckleshoot Tribe, whose fishing areas include Lake Washington (including the Ship Canal above the Ballard Locks) and the Duwamish River. Also, the fishing area of the Suquamish Tribe include the marine waters of central Puget Sound, including Elliot Bay. The Muckleshoot Indian Tribe has a staff of fisheries biologists, operates two salmon hatcheries, one of which is on a Green River tributary, and has taken an active role in managing salmon in the project area.

Tribal fishing can occur at multiple locations within the Ship Canal including each of the alternative crossing locations for the Green Line bridge. Since the area is within recognized and affirmed treaty fishing areas, and could potentially impact access to these areas, coordination with the Muckleshoot Tribe has been initiated and will continue to resolve potential conflicts prior to construction. The SMP intends to implement measures that will reduce the likelihood of conflict including coordination with the Muckleshoot Tribe to document important access points in areas where project-specific actions will occur. Adherence to designated fish windows as outlined by the appropriate agencies (WDFW, NOAA Fisheries, and USFWS) will eliminate or reduce in-water interference during periods when returning adult salmonids are present.

Segment 6: West Seattle

Duwamish River. Within Segment 6 fish and aquatic habitat potentially affected by the Green Line alternative alignments are present in the Duwamish River and Longfellow Creek. Two alternative alignments are identified for the Green Line crossing of the Duwamish River. Alternative 6.1 (West Seattle I) or Alternative 6.1(s) (West Seattle I single beam) would provide a guideway built on top of the existing West Seattle Bridge that would depart the bridge either west of the greenbelt at Pigeon Point (Alternative 6.1.1 or 6.1.1(s)) or through the north end of the greenbelt (Alternative 6.1.2 or 6.1.2(s)). (see Chapter 3 for maps and a more detailed description). Alternative 6.2 (West Seattle II) would provide a new, monorail-only bridge adjacent to the north side of the existing West Seattle Bridge. Neither alternative would involve any new, permanent structures in-water, although work would occur over or

near the water during the construction period and construction could involve the placement of temporary structures in the East Waterway (see Section 4.17, Construction).

Aquatic habitat at the alternative Green Line crossings of the Duwamish River supports anadromous salmonids, estuarine fishes, and birds that prey on these species. Habitat conditions are highly influenced by the previous dredging and filling of the Duwamish River. Currently, there is a straightened river channel with narrow intertidal mud flats extending to steep middle and upper intertidal shorelines in the West Waterway. At the crossing location the East Waterway is a narrow, shallow channel navigable only by small craft due to the low level railroad bridge and Spokane Street Bridge, both of which are fixed at a low level above the high tide elevation (~ + 25 ft mean lower low water(MLLW)). The West Waterway navigation channel is U-shaped with a bottom at about -20 feet MLLW. At the Green Line crossing location, the navigation channel extends to near the shoreline, providing steep intertidal and shallow subtidal substrate. The shorelines have industrial, commercial, and residential uses extending to and, in some cases, over the shoreline. The channel profile characteristics, straight shorelines, absence of off-channel habitat, and steep hardened upper intertidal areas provide little refugia, foraging habitat, or reduced current velocities for juvenile salmonids migrating through the Green Line crossing location. The West Waterway channel is deeper and wider than the East Waterway channel. Thus, the West Waterway carries the majority of Duwamish River flow and apparently most of the anadromous fish.

Members of the Muckleshoot Tribe and other tribes, including the Suquamish, harvest adult salmon in the lower Duwamish Waterway. Tribal fishing can occur at multiple locations within the Duwamish East and West Waterways, including the immediate vicinity of the West Seattle Bridge where the Green Line guideway would cross the waterways.

Near the project site, water quality is a potential limiting condition, with high temperatures and low dissolved oxygen levels occurring downstream from RM 5.2 during summer low flow periods. The Duwamish River is on the Washington Department of Ecology's 303(d) list of impaired water bodies for multiple sites and parameters. Under the proposed WAC 173-201A-200 (Fresh Water Designated Uses and Criteria), the Duwamish River would likely be designated for Aquatic Life Uses such as salmon, steelhead, and trout rearing. Although water in the Duwamish River is only listed for exceeding pH, fecal coliform bacteria, and dissolved oxygen standards, sediments exceeded standards for numerous chemicals including a variety of metals, PAHs, PCBs, phthalate esters, and phenol (Ecology 2000).

The Duwamish River is a migration and rearing area for anadromous salmonids, with no spawning or early rearing habitat available in this estuarine reach of the Green-Duwamish River system (Weitkamp and Ruggerone 2000). Three Pacific salmon species inhabit the Green-Duwamish River basin in significant numbers: Chinook, coho, and chum salmon. Pink (*O. gorbuscha*) and sockeye salmon may occasionally occur in the Green-Duwamish River basin, but the Green River is primarily a chum, coho, and Chinook salmon stream (Williams et al. 1975). Anadromous game fish using these waters include steelhead, sea-run cutthroat trout, Dolly Varden (*Salvelinus malma*), and bull trout (*S. confluentus*). Juvenile salmonids present at the West Seattle bridge site include subyearling Chinook, chum, and pink salmon that migrate downstream through the Duwamish Waterway on their way to Puget Sound. Yearling coho and steelhead salmon also migrate to Puget Sound through the Duwamish Waterway. Subadult and adult bull trout and cutthroat trout also migrate in both directions through the Duwamish Waterway. Adults of each salmon species migrate upstream through the Duwamish Waterway to the Green River and its tributaries. Spawning and early rearing of all salmonids takes place in the Green River portion of the system and in major tributaries.

Other fish species found in the Duwamish estuary (Matsuda et al. 1968) and likely to be found at the West Seattle Bridge crossing include those listed in Table 4.15-2. Many of these species are likely to occur within the West Seattle Bridge vicinity at most times of the year.

The Duwamish River is an important corridor for juvenile salmon migrating from the upper Green River toward Elliott Bay and the Pacific Ocean. However, the river at the West Seattle Bridge currently provides highly modified rearing and migratory habitat for salmon and other marine organisms. The armored shorelines (riprap, bulkheads, etc.) along the river in the Green Line project area provide minimal habitat for young salmon during their estuarine rearing period. Recovery plans now underway for threatened and endangered salmon will address potential means of enhancing habitat so it will be more favorable to the survival and growth of young salmon from the Green-Duwamish River system. All adult salmon returning to the Green-Duwamish River also migrate upstream through the Duwamish Waterway, but have no identified specific habitat requirements during their migration through the lower river.

The West Seattle Bridge area does not provide refugia or migration barriers to anadromous salmonids or other fish species. The shorelines of the dredged channels produce epibenthic zooplankton prey supporting juvenile salmonids during their spring migration through the Duwamish estuary. Bull kelp (*Nereocystis luetkeana*) occurs in portions of the East Waterway, including a substantial bed previously reported by the Port of Seattle under the West Seattle Bridge; however, this bed was not seen in June 2003. This shallow water habitat provides potential refuge and foraging habitat for those young salmon that migrate through the East Waterway.

Visual inspection of the potential Duwamish crossing site by a fish biologist (June 3, 2003, -1.7 MLLW) indicates that the site does not provide spawning or other habitat supporting forage fish. The site is at the lower end of the Duwamish estuary within the relatively high salinity range commonly used by both marine and estuarine fishes. The potential freshwater species would be limited to areas of the upper estuary. Fresh water occurs at all depths and tides at RM 10.4, but salinities between 25 and 28 parts per thousand were found upstream at RM 7.5 at depths below three feet (King County et al. 2000). However, there is no habitat present known to support spawning by Puget Sound forage fish. Pacific herring and sand lance are likely to forage within the water column of the West Waterway. The low level Spokane Street bridge over the East Waterway adjacent to the freeway bridge, together with the relatively restricted flow through the narrower constriction of the East Waterway, likely provides sufficient shading to discourage use of this area by forage fish.

There are no unique or specific habitat features at the project site supporting any of the various estuarine species previously identified in the Duwamish Waterway (see Table 4.15-2).

Table 4.15-2. Fish Species Likely to Occur at the West Seattle Bridge Site in the Duwamish River

Common Name	Scientific Name	Occurrence
Pacific lamprey	<i>Entosphenus tridenatus</i>	Occasional
Pacific herring	<i>Clupea harengus pallasi</i>	Rare
chum salmon	<i>Oncorhynchus keta</i>	Common
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	Common
coho salmon	<i>Oncorhynchus kisutch</i>	Common
rainbow / steelhead	<i>Oncorhynchus mykiss</i>	Common
cutthroat trout	<i>Oncorhynchus clarki clarki</i>	Occasional
bull trout	<i>Salvelinus confluentus</i>	Rare
mountain whitefish	<i>Prosopium williamsoni</i>	Occasional
northern pikeminnow	<i>Ptylocheilus oregonensis</i>	Occasional
longnose dace	<i>Rhinichthys cataractae</i>	Common
speckled dace	<i>Rhynchichthys osculus</i>	Occasional

Table 4.15-2. Fish Species Likely to Occur at the West Seattle Bridge Site in the Duwamish River (continued)

Common Name	Scientific Name	Occurrence
largescale sucker	<i>Catostomus macrocheilus</i>	Common
threespine stickleback	<i>Gasterosteus aculeatus</i>	Common
shiner perch	<i>Cymatogaster aggregata</i>	Occasional
prickly sculpin	<i>Cottus asper</i>	Occasional
buffalo sculpin	<i>Enophrys bison</i>	Occasional
Pacific staghorn sculpin	<i>Leptocottus armatus</i>	Common
starry flounder	<i>Platichthys stellatus</i>	Occasional

Sources: Matsuda et al. (1968); Wydoski and Whitney (1979); Weitkamp and Ruggerone (2002).

Longfellow Creek. The Green Line guideway is proposed to cross Longfellow Creek at various locations with several of the different alternatives being considered for this vicinity. The current alternatives have been revised and updated from those considered in the Draft EIS. The Preferred Alternative (Alternative 6.3(s)) would avoid impacts to Longfellow Creek and its riparian habitat by placing the guideway and Delridge station north of where the stream enters the 3,161 foot-long pipe that discharges to the Duwamish West Waterway.

Alternative 6.1 would cross Longfellow Creek upstream from the entrance to the long culvert that discharges to the Duwamish West Waterway (see Chapter 3 for maps and a more detailed description of all alternatives). The guideway would be approximately 70 to 75 feet above Longfellow Creek at the crossing. No in-water structures would occur at the Longfellow Creek crossing that would potentially modify existing conditions. The Delridge station and support columns for the Green Line would occur within 200 feet of the ordinary high water of Longfellow Creek with Alternative 6.1. On the east side of the culvert the support columns would be within the Delridge Station footprint. On the west side of the culvert the support columns would be 50-80 feet from the creek channel within the western edge of the recently planted riparian area. Field observations indicate that planted vegetation (trees, grass and shrubs), roads, driveways, and buildings characterize the riparian area (stream banks) at the site of the crossing.

With Alternative 6.2 the guideway would pass over Longfellow Creek at SW Andover Street where the stream is contained within the long culvert that discharges to the Duwamish West Waterway. No stream or riparian habitat would be altered by the guideway with this alternative. The Delridge Station for this alternative would also be located outside the stream habitat and riparian corridor.

Alternative 6.3(s) would pass north of the Nucor steel mill avoiding the Longfellow Creek stream and riparian habitat. This alternative would cross the stream where it is within the long culvert discharging to the Duwamish West Waterway. The culvert is under existing roads and parking areas along this alignment.

Alternative 6.4 (Andover/Yancy) would pass over Longfellow Creek along the south side of SW Andover Street. At this location Longfellow Creek is contained within the long culvert discharging to the Duwamish West Waterway and has no riparian habitat. Alternative 6.4(s) would follow the same alignment, but would not include a station in the Delridge area.

Alternative 6.5 (Genesee) would locate the guideway along Delridge Way SW between the West Seattle Bridge and SW Genesee Street, and cross over Longfellow Creek at SW Genesee Street. The guideway would be above the roadway avoiding any alteration of Longfellow Creek and its riparian habitat. The

station would be located along Delridge Way SW avoiding any alteration of Longfellow Creek and its riparian habitat.

Longfellow Creek flows from a watershed area of approximately 2,685 acres and extends about 4.2 miles through the West Seattle area. Downstream from the proposed Green Line crossing, the lower 3,161 feet of the creek are completely contained within a culvert. Land use in the segment between the culvert intake at SW Andover and SW Genesee Streets is predominantly scattered residential and industrial. A 5.65-acre open space lies between SW Yancy and SW Genesee Streets, which includes the northern portion of the Longfellow Creek open channel. The alignment of the Preferred Alternative would pass over the portion of Longfellow Creek contained within the long culvert that begins at the northern edge of this greenspace.

Historically, Longfellow Creek was thought to contain populations of coho salmon, cutthroat trout, and steelhead trout (King County et al. 2000), although the Washington State Department of Fish and Wildlife (WDFW) Spawning Ground Survey Database (1999) does not contain any indication of adult salmonid observations in Longfellow Creek for any species. Currently, about 2,000 lineal feet of the creek are available to anadromous salmonids for spawning and rearing. This area extends upstream from the pipe entrance near SW Andover Street up to the passage barrier within the West Seattle Golf Course. Although Seattle Public Utilities (SPU) did not begin conducting formal spawning surveys in Longfellow Creek until 1999, approximately 44 adult Coho salmon (live and dead) were observed in the creek downstream of SW Genesee Street. Spawning surveys conducted by Washington Trout under contract to SPU resulted in the following counts of adult Coho carcasses: 92 in 1999, 282 in 2000, 270 in 2001, and 166 in 2002, and in the following counts of adult chum carcasses: 67 in 2001, and 21 in 2002. According to City of Seattle biologists, comparisons of daily and weekly spawning survey counts have demonstrated that some of the carcasses were overlooked and thus the creek may have higher counts of fish. (Information provided from City of Seattle, please see comment letters and responses in Volumes Five and Six of this Final EIS.)

In addition, in 1999, juvenile rainbow trout and coho salmon were captured during electrofishing surveys from the mouth up to SW Graham and SW Oregon Streets, respectively (King County et al. 2000). Currently, Longfellow Creek appears to have a sustaining population of coho and chum salmon based on observed numbers of returning adults, redds, and rearing juveniles. One Chinook salmon redd was identified in the creek by SPU. The populations have been supplemented or established by hatchery fish (King County et al. 2000). Many schools have released coho salmon fry into Longfellow Creek over several years. Recently coho smolts and juvenile coho have been observed rearing in portions of Longfellow Creek (King County et al. 2000).

The State of Washington classifies waters of the state according to their intended habitat and other uses, and natural characteristics. Longfellow Creek is designated as a Class A (Appendix 5.15 B) stream by the WDFW and Washington State Department of Ecology (Ecology). Longfellow Creek is considered a tributary to the Duwamish River, which is designated as a Class B surface water (Chapter 173-201A WAC). Under the proposed WAC 173-210A-200 Fresh Water, Longfellow Creek would likely be designated for Aquatic Life Uses such as salmon, steelhead, and trout spawning and rearing. The volume and degraded quality of stormwater entering Longfellow Creek from existing sources is likely detrimental to salmonid production. The Longfellow Creek Wastewater Management Committee identified the issues associated with high stormwater flows and increased urban runoff as principal problems facing the creek (King County et al. 2000). Today, Longfellow Creek receives surface water from natural areas in addition to stormwater runoff from streets, from paved areas such as parking lots, and from a series of constructed ditches. Some of these ditches are lined with impervious materials while others have rocks or vegetation.

Longfellow Creek has received major habitat restoration efforts in recent years. The City of Seattle Public Utilities, the Longfellow Creek Advisory Council, Longfellow Creek Watershed Action Project, Delridge Neighbors Planning Project, and volunteers have undertaken numerous actions to restore and protect Longfellow Creek and its adjacent vegetation. Much of this effort has focused on the 2,000-foot reach from the pipe entrance near SW Andover Street upstream to the West Seattle Golf Course. A meeting with Longfellow Creek representatives of SPU (July 17, 2003) identified this reach as the only portion of the stream currently available to anadromous salmon for spawning and rearing. Only Alternative 6.1, Delridge 1, would cross the open channel of Longfellow Creek.

4.15.1.2 Wildlife and Terrestrial Habitat

Wildlife in the urban environment of Seattle along the Green Line alternative alignments consists of birds and mammals. The highly developed urban environment of the Green Line route provides limited habitat for both these groups. Street trees and buildings provide some limited habitat for birds (avifauna) that routinely occur in highly developed urban areas.

Birds

A number of bird species may occur in the moderately vegetated and poorly vegetated habitats along the Green Line route for any of the identified alternatives. Table 4.15-3 lists species that may be found in the sparse vegetation of urban areas such as street trees. Some of these birds may nest in street trees along the Green Line corridor while others will only forage or roost in the trees. It is not likely the street trees provide major habitat functions for urban birds. The sparse spacing of street trees along the edges of roadways throughout most of the Green Line alignment does not provide sufficient cover to serve as corridors for birds other than those commonly found in highly developed urban environments.

Table 4.15-3. Birds Commonly Found in Moderately and Poorly Vegetated Urban Habitats of Puget Sound

Glaucous winged gull	Bewick's wren	Wilson's warbler	House finch
Rock dove	Ruby-crowned kinglet	Black-headed grosbeak	Golden-crowned kinglet
Anna's hummingbird	American robin	Evening grosbeak	Dark-eyed junco
Northern flicker	Bohemian waxwing	Rufous-sided towhee	Northern oriole
Downey woodpecker	Cedar waxwing	Fox sparrow	Red-breasted nuthatch
Steller's jay	European starling	Song sparrow	Violet-green swallow
American crow	Yellow-rumped warbler	Golden-crowned sparrow	European starling
Black-capped chickadee	Spotted towhee	White-crowned sparrow	Bushtit
Chestnut-backed chickadee	Winter wren	House sparrow	

The highly developed urban nature of both the site for the Green Line alternatives and the surrounding area limit wildlife to those species adapted to urban habitats. Priority Habitats and Species (PHS) data from WDFW do not indicate any species of concern or state-monitored species within the project area. While nesting bald eagles are not found within the Green Line corridor or its immediate vicinity, bald eagles may be present during the wintering period, which extends from October 31 to March 31. There are, however, few trees along the alternative alignments or at the Ship Canal and Duwamish River crossings that are large enough to for eagles to select as perch trees. There are several large Sequoias and cedars north of Key Arena near Mercer Street that City of Seattle staff have observed being used as perch trees by a bald eagle (observations by Seattle Center staff, reported by Margaret Glowacki, City of Seattle). The only other vegetation of a size appropriate for bald eagle perch trees within the alternative

alignments is at Pigeon Point near the West Seattle Bridge, about ¼-mile west of the Duwamish West Waterway.

Ospreys may also be found foraging in the project area; however, the closest known breeding territory along the alternative alignments is about 1 mile from the West Seattle Bridge crossing and near the downtown portion of the corridor.

There is a peregrine falcon eyrie on the West Seattle Bridge. This is a constructed nest box on the support structure underneath the bridge.

At the West Seattle Bridge location, there is habitat on Pigeon Point that potentially supports wildlife. At the Pigeon Point site, no large snags, nesting cavities in trees, or other notable habitat features were observed in the trees. There are several large maples and cottonwood trees that could potentially support raptor nests, but no nests are currently present. The site potentially provides habitat for raptors, but no evidence of current use was observed by an April 2003 field survey conducted for the Green Line project. A more detailed survey of wildlife using the area potentially disturbed would be conducted if an alternative alignment is selected that passes through the Pigeon Point greenbelt.

Mammals

Mammalian species that may occur within the Queen Anne-Kinnear Park, Pigeon Point Greenbelt, the Longfellow Creek riparian corridor, and other smaller vegetated areas include those listed in Table 4.15-4. Some of these species are likely to reside within the vegetated corridors while others may use the areas as migratory and foraging corridors. A beaver lodge has been reported to be present on Longfellow Creek upstream from the potential Green Line crossing (meeting with Seattle Public Utilities staff July 17, 2003).

Table 4.15-4. Mammals that May Occur within Urban Habitat such as the Queen Anne-Kinnear Park, Pigeon Point, and Longfellow Creek Vegetated Habitats

Common Name	Scientific Name	Common Name	Scientific Name
Common opossum	<i>Didelphis marsupialis</i>	northern flying squirrel	<i>Glaucomys sabrinus</i>
masked shrew	<i>Sorex cinereus</i>	beaver	<i>Castor canadensis</i>
vagrant shrew	<i>Sorex vagrans</i>	deer mouse	<i>Peromyscus maniculatus</i>
dusky shrew	<i>Sorex monticolus</i>	Bushy-tailed woodrat	<i>Neotoma cinerea</i>
Northern water shrew	<i>Sorex palustris</i>	boreal red-backed vole	<i>Clethrionomys gapperi</i>
Pacific water shrew	<i>Sorex bendirii</i>	western red-backed vole	<i>Clethrionomys occidentalis</i>
Trowbridge's shrew	<i>Sorex trowbridgii</i>	Townsend's vole	<i>Microtus townsendii</i>
shrew-mole	<i>Neurotrichus gibbsii</i>	long-tailed vole	<i>Microtus longicaudus</i>
Townsend mole	<i>Scapanus townsendii</i>	Richardson's vole	<i>Microtus richardsoni</i>
Pacific mole	<i>Scapanus orarius</i>	Oregon meadow mouse	<i>Microtus oregoni</i>
little brown myotis	<i>Myotis lucifugus</i>	muskrat	<i>Ondatra zibethicus</i>
Yuma myods	<i>Myotis yumanensis</i>	House mouse	<i>Mus musculus</i>
California myotis	<i>Myotis californicus</i>	Pacific jumping mouse	<i>Zapus trimtatus</i>
silver-haired bat	<i>Lasionycteris noctivagans</i>	Norway rat	<i>Rattus norvegicus</i>
big brown bat*	<i>Eptesicus fuscus</i>	black rat	<i>Rattus rattus</i>
hoary bat	<i>Lasiurus cinereus</i>	coyote	<i>Canis latrans</i>
Townsend's big-eared bat*	<i>Plecotus townsendii</i>	red fox	<i>Vulpes fulva</i>
long-eared myotis	<i>Myotis evotis</i>	raccoon	<i>Procyon lotor</i>
domestic rabbit	<i>Oryctolagus cuniculus</i>	ermine	<i>Mustela erminea</i>
eastern cottontail	<i>Silvilagus floridanus</i>	long-tailed weasel	<i>Mustela frenata</i>
snowshoe hare	<i>Lepus americanus</i>	Mink	<i>Mustela vison</i>

Table 4.15-4. Mammals that May Occur within Urban Habitat such as the Queen Anne-Kinnear Park, Pigeon Point, and Longfellow Creek Vegetated Habitats (continued)

Common Name	Scientific Name	Common Name	Scientific Name
mountain beaver	<i>Aplodontia rufa</i>	spotted skunk	<i>Spilogale putorius</i>
Porcupine	<i>Erethizon dorsatum</i>	river otter	<i>Lutra canadensis</i>
Townsend's chipmunk	<i>Tamias townsendii</i>	striped skunk	<i>Mephitis mephitis</i>
Cascades golden-mantled ground squirrel	<i>Callospermophilus saturatus</i>	domestic dog	<i>Canis familiaris</i>
eastern gray squirrel	<i>Sciurus carolinensis</i>	domestic cat	<i>Felis domesticus</i>
Douglas squirrel	<i>Tamiasciurus douglasii</i>	Black-tailed deer	<i>Odocoileus hemionus</i>

* Priority Species as listed By the Washington Department of Fish and Wildlife.

4.15.1.3 Vegetation

This section describes aquatic, riparian, and terrestrial vegetation resources along the Green Line route that provide some habitat value for birds, mammals, and fish resources of the area. Planted vegetation is present along Green Line alignment alternatives, including street trees. Please see the subsection below for discussion of the street tree resources through out the Green Line route and Appendix W, Tree Inventory. Along most of the Green Line alternative alignments, vegetation consists of trees and plants maintained by the City of Seattle or adjacent property owners. A few exceptions occur, as was discussed above in Section 4.15.1.2, Wildlife, and are described in the following paragraphs. There are two wetlands along the Green Line route that could be affected by the construction or operation of the system (Pete Lawson, Parametrix, Inc., site inspection May 2003, see also Appendix RR).

Segment 1: Ballard Segment

Lake Washington Ship Canal. The Lake Washington Ship Canal (see Figure 3.5a in Chapter 3) has little vegetation of any nature, neither aquatic nor terrestrial. Intense commercial development of the riparian areas, shorelines, and shallow-water areas prevents both terrestrial and aquatic vegetation from developing at most of the areas of the proposed crossing locations. A small amount of riparian vegetation occurs on the north side of the Ship Canal immediately east of the Ballard Bridge. This landscaped area is part of the Seattle Maritime Academy grounds. The area between the parking lot and the water's edge has a dense thicket of native and exotic shrubs and trees, including several 20- to 25-foot willows, a 40-foot birch, a 15- to 20-foot madrone (diameter at breast height about 10 inches), several 10- to 15-foot Pacific crabapples (diameter at breast height about two to four inches), a thicket of 15-foot mock orange, and several buddleia (see Appendix W of the Draft EIS, Tree Inventory).

Segment 2: Interbay/Magnolia Segment

Queen Anne Greenbelt/Kinnear Park. The Interbay/Magnolia segment alternatives are located near a relatively steep west-facing slope, with gradients averaging about 20 percent, although some small areas have exposed bedrock cliffs, with nearly vertical slopes. The primary habitat feature in the area is a patch of deciduous forest, the Queen Anne Greenbelt, located to the east of 15th Avenue W in a steeply sloping area between W Garfield Street and W Howe Street.

This area is typical of small, urban, forested areas that have a mix of native and non-native plant species. The overstory of the forest patch is dominated by bigleaf maple (*Acer macrophyllum*), most of which range in height from 40 to 80 feet. Some scattered black cottonwood (*Populus balsamifera* var. *trichocarpa*) and red alder (*Alnus rubra*) are present on the site. The only conifers observed are a small clump of young western hemlock (*Tsuga heterophylla*), located between the Magnolia Bridge off-ramp and a commercial building, which were likely planted for landscaping purposes. No large snags, nesting

cavities in trees, or other notable wildlife habitat features were observed in the trees near W Garfield Street.

English ivy (*Hedera helix*), an exotic, invasive species, is pervasive throughout much of the area, having climbed most of the trees on this forest patch as well as constituting much of the ground cover. Himalayan blackberry (*Rubus discolor*) is present in the understory of the forest, as well as predominating in several, large, non-forested shrub patches. Other shrub species present in the understory include salmonberry, red elderberry, rhododendron (*Rhododendron* sp.), and Indian plum. Herbaceous species observed include vanilla leaf (*Achlys triphylla*), horsetail (*Equisetum hyemale*), and stinging nettle (*Urtica dioica*), the latter two of which are found in localized depressional wet areas on the site. These wet areas are several hundred feet away from the Green Line alignment. The forest has several footpaths and a garbage-strewn area that appears to be used as an urban campsite.

Directly west of 11th Avenue W, between W Galer and Garfield Streets, the trees have been cleared and the landform graded, possibly in preparation for development of the site. Planted grasses make up the vegetation, and several gravel roads run through this cleared area, which extends west to the Magnolia Bridge on-ramp. A paved/gravel private road extending off the west end of W Blaine Street provides access to this cleared area. This road runs through the deciduous forest before entering the clearing. Retaining walls have been installed both below (west) the residences on 11th Avenue W and 12th Avenue W, as well as immediately above (east) of the Magnolia Bridge on-ramp.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Green Line alignment along W Harrison Street (see maps Chapter 3) and across the Seattle Center includes street trees that are at a mature size. These trees are primarily non-native species such as London plane but include some planted native species on the Seattle Center grounds. Pruning and removal of trees is regulated by the City of Seattle (Tree Protection SMC 25.11, DR 6-2001, and CAM 242). Many of the trees are greater than 6 inches in diameter, but none are more than 2 feet in diameter. There are no “Exceptional Trees” (Seattle DCLU Directors Rule 6-2001) along the route. These trees potentially provide nesting, roosting, and feeding habitat for a variety of birds that are commonly found in the urban area of Seattle.

The Seattle Center trees are predominately London plane (*Platanus acerifolia*), sweetgum (*Liquidambar styraciflua*), Lombardy poplar (*Populus nigra "Italica"*), honey locust (*Gleditsia triacanthos*), shore pine (*Pinus contorta*), and zelkova (*Zelkova serrata*). Small numbers of katsura (*Cercidiphyllum japonicum*), jocquemontil birch (*Betulus jacquemontii*), service berry (*Amelanchier* sp.), red oak (*Quercus rubra*), and Norway maple (*Acer platanoides*) also are present on the Seattle Center grounds. Near the Kobe Bell on the north side of the International Fountain Plaza, there are several trees of special significance, including the Daimyo Oak, planted in 1932 by the Daughters of the American Revolution, and the Mount Fuji cherry, donated to the City of Seattle by Japan’s crown prince Akihito in 1975. The London plane trees are considered by the Seattle Center to be part of the structural framework of the Seattle Center grounds. The Seattle Center attempts to preserve these trees, which are part of the Richard Haag design. The Seattle Center also attempts to preserve the London plane trees along both sides of Mercer Street on the north side of the Seattle Center.

Segment 4: Downtown Segment

The Downtown Segment does not have any native vegetation, but planted street trees are present at some locations along the route. A large redwood tree (*Sequoia* sp.) exists in a center island of Stewart Street between Third Avenue and Fourth Avenue (see map Chapter 3).

Segment 5: SODO Segment

No significant native or planted vegetation occurs along the Green Line alternatives within the SODO Segment. See Appendix W for a survey of street trees along the Green Line route.

Segment 6: West Seattle Segment

The West Seattle Segment has vegetation resources at several locations that would potentially be altered by the Green Line. These include aquatic and riparian vegetation at the Duwamish Water crossing location, forest vegetation of the Duwamish Green Belt at Pigeon Point, and riparian vegetation along the Longfellow Creek channel south of Andover Street SW.

Duwamish Waterway Vegetation. The Duwamish River crossings have very little vegetation, other than within the Duwamish River East Waterway. Small amounts of grass, weeds, and Himalayan blackberries are present in some areas along the shorelines under the West Seattle Bridge and the Alternative 6.1.2 alignment. Several non-native plant species are known to occur in the Green-Duwamish Estuary, including common reed (*Phragmites australis*), Himalayan blackberry, evergreen blackberry (*R. laciniatus*), Japanese knotweed (*Polygonum cuspidatum*), and reed canarygrass (*Phalaris arundinacea*). Blackberry shrubs are the most common shrub species present along the Duwamish River. Other species of concern in the estuary include common tansy (*Tanacetum vulgare*), yellow iris (*Iris pseudacorus*), and Scots broom (*Cytisus scoparius*) (King County et al. 2000). However, these riparian species occur upstream from the West Seattle Bridge.

In the past, the East Waterway has had a substantial bull kelp (*Nereocystis luetkeana*) bed extending south from the Spokane Street Bridge to underneath the West Seattle Bridge. However, a visual survey by boat during a two-foot MLLW tide of June 3, 2003 did not detect any bull kelp in this area. Various unidentified brown and red macroalgae were present in shallow water. Bull kelp and the macroalgae potentially provide habitat used by a variety of estuarine fishes and invertebrates, including juvenile salmon. Other aquatic vegetation is limited primarily to diatoms, which grow on much of the intertidal substrate during the spring and summer, and phytoplankton in the water column. The diatoms provide a forage base for epibenthic zooplankton, which provide prey for young Chinook and chum salmon as they migrate through this area. No eelgrass is present within the two dredged waterways. The channel bottom of the East Waterway is sufficiently shallow and navigation sufficiently restricted to allow marine macroalgae to grow at this location, but not at other portions of the waterway other than attached to piles and shoreline rock rip rap. Small amounts of various marine macroalgae grow on the peripheral pilings of shoreline structures in this area. No marsh vegetation is present within the project site or adjacent shorelines.

Pigeon Point Vegetation. The Pigeon Point area of West Seattle is located immediately south of the West Seattle Bridge on the west side of the Duwamish River (see maps Chapter 3). This location is a steep hillside with remnant natural vegetation that could support wildlife. The vegetation provides potential nesting, roosting, and feeding habitat functions for a wide range of small birds and potentially for raptors. Small mammals, such as rodents, raccoons, and coyotes, may migrate through and forage in this habitat.

The steep hillside portion of Pigeon Point is covered by deciduous forest vegetation. A 150- to 300-foot-wide strip of deciduous forest surrounds the point on three sides. Forested areas are located on the slopes west of 21st Avenue SW, north of SW Charlestown Street, and east of 19th Avenue SW. These slopes range from about 20 to 25 percent gradients (west and north slope) to about 40 percent gradients (east slope). The forest overstory is dominated by bigleaf maple, with most in the range of 40 to 80 feet tall. A few black cottonwood trees are also present. The northern portion of the point nearest the West Seattle Bridge has smaller trees with heights generally from 20 to 40 feet. Coniferous trees, including a few

Douglas fir (*Pseudotsuga menziesii*), western hemlock, western red cedar (*Thuja plicata*), and Pacific madrone (*Arbutus menziesii*) are scattered throughout the area. The conifers are concentrated adjacent to houses and in the area west of 22nd Avenue SW. A more detailed analysis of vegetation species and identification of trees to be removed would be conducted if an alternative alignment is selected that would pass through the Pigeon Point greenbelt.

Both English ivy and Himalayan blackberry occur in the forest understory. On the higher elevation portions of the hill slope, these species are the dominant understory species. Shrub species present in the understory include red-flowering currant (*Ribes sanguineum*), salmonberry (*Rubus spectabilis*), red elderberry (*Sambucus racemosa*), and Indian plum (*Oemleria cerasiformis*). Herbaceous species including sword fern (*Nephrolepis exaltata*), horsetail, and stinging nettle, are present in wetter areas at the base of the slope. These seep areas do not appear to be wetlands.

Alternative 6.1.1 (Past Pigeon Point), Alternative 6.2 (New Bridge) and Alternatives 6.3(s), and 6.4 would avoid the Pigeon Point Greenbelt (see maps Chapter 3). However, Alternative 6.1.2 (To Pigeon Point) would place bridge support columns within the lower edge of the densely vegetated Pigeon Point slope described above.

Longfellow Creek Vegetation. Most alternatives, including the Preferred Alternative would avoid the riparian area and floodplain of Longfellow Creek. However, the riparian area of Longfellow Creek is vegetated where columns may be constructed on either side of the creek to support the Green Line guideway for Alternative 6.1, Delridge 1. This alignment alternative would pass over the open channel portion of Longfellow Creek between SW Yancy Street and SW Andover Street. The location is immediately upstream from the point where Longfellow Creek enters the 3,161-foot-long pipe that discharges to the Duwamish West Waterway, and near the foot bridge that crosses the stream. Riparian vegetation at this location is a mix of native and introduced species (Himalayan blackberry, grasses, etc.). This riparian vegetation is the downstream end of a 5.65 acre habitat corridor extending along Longfellow Creek.

South of SW Andover Street, the riparian vegetation along Longfellow Creek at the pipe entrance includes several tall willows and bigleaf maples (20 to 40 feet). Upstream from the culvert, riparian vegetation is dense, predominantly grasses and several recently planted Douglas firs (about 10 feet tall). Newly planted deciduous trees continue around the edge of the parking lot to the west. Small trees, shrubs, tall grasses, and Himalayan blackberries form substantial canopy over Longfellow Creek at the location of the potential Green Line crossing. There are no quantifiable data available on canopy coverage or age for Longfellow Creek, but the riparian habitat was considered “fair to good” in the lower portions of this reach and “lacking” in the upper portions (King County et al. 2000). Upstream from Genesee Street, the creek flows through a wooded ravine in the West Seattle Golf Course. Exotic species of plants more closely associated with riparian and aquatic environments that are abundant throughout this subbasin include Scots broom, reed canarygrass, Himalayan blackberry, and a wide variety of residential landscape vegetation.

Street Trees

Street trees support bird species highly adapted to the urban environment, commonly nesting and foraging in man-made habitats. Habitat supporting native bird species requires substantial areas of tree coverage and density of trees as opposed to dispersed lines of trees along street edges. Donnelly (2002) found bird habitat quality to be at least as important as habitat quantity and pattern. Larger habitat reserves contained richer communities, greater habitat diversity, and a greater abundance of birds than smaller reserves. However, even small reserves contain much more and denser trees than is provided by street trees along the Green Line route. Native bird species tend to be present and more abundant in habitat

reserves greater than 104 acres, surrounded by less than 40 percent urban land cover, and containing little exotic vegetation. These conditions are not provided by street trees or any of the vegetated areas potentially affected by the Preferred Alternative. Only Alternative 6.1.2 for the Pigeon Point area (which is not part of the Preferred Alternative) has the potential to affect habitat of this nature. The following describes the street tree resources occurring in each Green Line segment.

Segment 1: Ballard Segment

Vegetation in this segment consists primarily of street trees and minimal ornamental plantings in commercial areas. Open space is associated with Ballard High School, several elementary schools, and diverse residential plantings. Approximately 150 red maple, linden, and sweet gum are present along the west side of 15th Avenue NW.

Segment 2: Interbay/Magnolia Segment

Greenbelts cover much of these adjacent slopes. Other vegetation includes modest ornamental plantings, plantings in the Interbay P-Patch, and the broad lawn areas of the Interbay Athletic Complex (see also Section 4.10, Parks and Recreation). Over 150 red maple, hornbeam, zelkova, purple plum, and sweet gum are present along the route within Segment 2.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

In the neighborhoods to the north and west of the Center and within the Center, there is abundant vegetation in the form of mature street trees, residential yards and gardens, and landscaping around business properties. Mercer Street (a SEPA scenic route) is lined with mature trees and is the theater boulevard for the Center. Fifth Avenue N is a tree-lined thoroughfare through a commercial and business zone. First Avenue N is a one-way, urban neighborhood street with low-rise apartment and office buildings and street trees. The landscape plantings in Seattle Center are also diverse in size, age, and design. There are several small courtyards and gardens with special plantings associated with certain buildings (e.g., Kobe Bell garden, Northwest Rooms' courtyard, Founder's Court). The street trees and the gardens in the Center create continuity between the landscapes of the Center and the surrounding neighborhoods.

Segment 4: Downtown/Pioneer Square Segment

Landscaping in this segment is urban and includes street trees from Union Street southward, several public plazas (including the Garden of Remembrance and Washington Mutual Building), and several plazas with planters. The triangle created by Stewart and Olive Streets and Fifth Avenue, called Times Square, is landscaped and has an eight- to nine-story redwood tree.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Vegetation in this segment consists largely of street trees.

Segment 6: West Seattle Segment

The rolling terrain in this segment includes two high, steep-sided ridges, consisting of West Duwamish Greenbelt and Pigeon Point and the landmass on which the majority of West Seattle is located. The ridges trend north to south, and are separated at their northern ends by a basin occupied by the Youngstown neighborhood and Longfellow Creek green space. Extensive greenbelts with mature trees cover western slopes in this segment, extending into the Longfellow Creek basin. Away from the greenbelts, existing tree cover consists primarily of street trees, highly diverse residential plantings, and several wooded parks.

4.15.1.4 Wetlands

The only identified wetlands that exist along any of the Green Line alternatives are in the West Seattle segment. There are two small wetlands located southwest of the SW Andover Street/26th Avenue South intersection, west of Longfellow Creek.

Wetlands in the Longfellow Creek area were delineated on December 23, 2003 and January 13, 2004. Wetlands were delineated using the methodology outlined in the *Washington State Wetlands Identification and Delineation Manual* (Ecology 1997) and in the *Corps Wetland Delineation Manual* (Environmental Laboratory 1987), i.e. to be considered a wetland, an area must have hydrophytic vegetation, hydric soils, and wetland hydrology. Data were collected on these parameters in areas representative of typical site conditions. Additional data were collected in associated uplands as needed to confirm wetland and stream boundaries. The wetland boundaries were delineated and flagged. The ordinary high water mark (OHWM) of Longfellow Creek was also flagged. Delineated wetlands and stream channels were surveyed and mapped. Refer to Appendix RR, Wetland Technical Report for a description of wetland plant indicator categories and criteria for wetland rating categories.

Two wetlands were delineated adjacent to Longfellow Creek at this site (Figure 4.15-1). Table 4.15-5 summarizes the classification and ratings of these wetlands, which are described in detail below. Refer to Appendix RR for a detailed description of the two wetlands.

Table 4.15-5. Summary of Wetlands Near Longfellow Creek

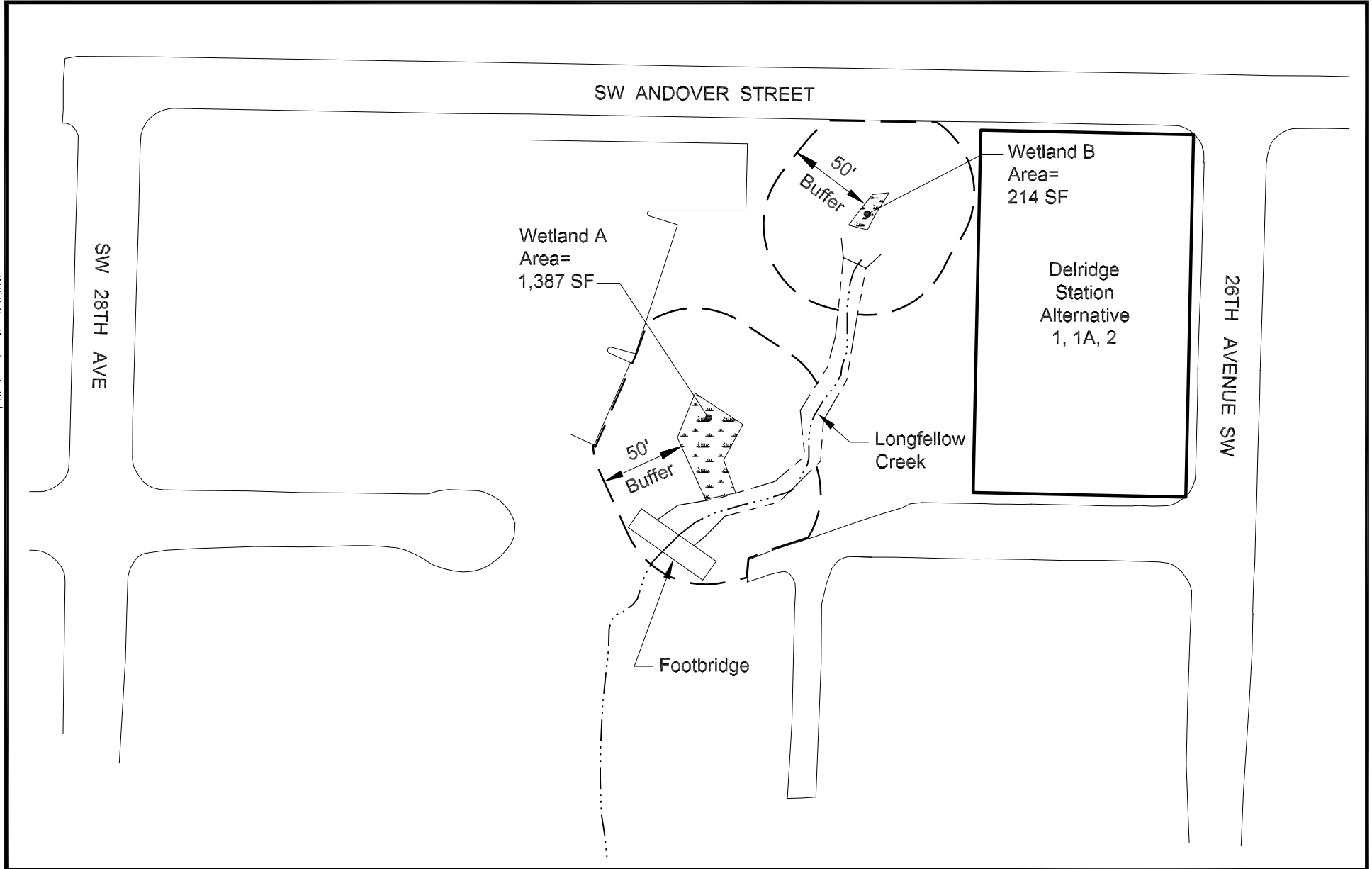
Alternative/ Station	Wetland	Watershed	Size ^a	Classification ^b (USFWS)	Ecology Rating ^c (Category)	Required Buffer ^d (in feet)
6.1/Delridge 2	A	Longfellow Creek	0.03 acre (1,387 square feet)	Emergent	III	50
6.4/6.4(s)/ Delridge 1, 1A	B	Longfellow Creek	<0.01 acre (215 square feet)	Forested	III	50

^a Wetland sizes are based on instrument survey by Parametrix, January 2004.

^b Cowardin et al. (1979). All wetlands are Palustrine.

^c Ecology (1993).

^d City of Seattle Municipal Code.



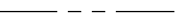
-  Wetland
-  Wetland Buffer
-  Ordinary High Water Mark (OHWM)
-  Creek

Figure 4.15-1
Wetland Locations near
Delridge Stations 1, 1A, and 2

4.15.1.5 Endangered Species and Essential Fish Habitat

This section analyzes the impacts of the project on species listed under the Endangered Species Act (ESA) and the impacts of the project on Essential Fish Habitat (EFH) (Magnuson-Stevens Act). SMP is working with federal agencies to identify endangered species within the action area and evaluate potential effects of the project on ESA listed species and Essential Fish Habitat. Federal regulations require the evaluation of these two topics where potential impacts may occur to listed species or their habitats. All Green Line alternative alignments cross areas where endangered species and EFH may occur, including the Lake Washington Ship Canal, the Duwamish River, and other habitats within the action area.

Endangered Species Act Listed Species

SMP has assembled information on rare, sensitive, threatened, and endangered plant species and on plant communities that may occur along each of the alternative alignments within the project vicinity from the Department of Natural Resources (DNR) Plant Natural Heritage Database. Information from the Washington Natural Heritage Program was received on March 14, 2003. The database did not include any threatened or endangered plants occurring within the vicinity of the project site. The U.S. Fish and Wildlife Service (USFWS) provided a list of federally threatened and endangered species for the lower Duwamish River area on August 6, 2002. No new listings for this area have occurred since that date. Representatives of NOAA Fisheries and the USFWS have been informed of the Green Line alignment alternatives and provided copies of the Draft EIS. Discussions with Services representatives have identified issues addressed in this document. SMP has prepared a Biological Evaluation for the Green Line, which will be submitted through the U.S. Coast Guard to NOAA Fisheries and the USFWS. See Appendix RR, Biological Evaluation.

The USFWS indicated that the coastal Puget Sound distinct population segment (DPS) of bull trout and wintering bald eagles may occur in the project vicinity. The USFWS recently declined to list the coastal cutthroat trout. Information on federally threatened and endangered species under the jurisdiction of the NOAA Fisheries was obtained from their web site at <http://www.nwr.noaa.gov/1salmon/salmesa/index.htm>. One threatened species, the Puget Sound population of Chinook salmon, was identified from the NOAA Fisheries web site. Chinook salmon occur within the Duwamish River and Ship Canal along the Green Line alternative alignments. One Chinook salmon redd was identified in Longfellow Creek by Catherine Lynch, Seattle Public Utilities. In addition, while coho are not listed, they are a candidate species and have been included in this analysis, as has designated critical habitat.

Consequently, this analysis describes existing conditions, habitat requirements, and project alternative direct impacts and indirect impacts to habitat and forage base for Chinook salmon, bull trout, coho, and bald eagles. Information on the ESA status and pertinent life history information is provided in Appendix V, Natural Resources Backup Information.

The Puget Sound stock of Chinook salmon is listed as threatened under the ESA. Chinook are present in the aquatic habitats provided by both the Lake Washington Ship Canal (Alternatives 1.1.1, 1.1.1(s), 1.1.2, and 1.2) and Duwamish Waterway (Alternatives 6.1 and 6.2) crossing locations as both juvenile downstream migrants and as adults returning to their natal streams to spawn. Both the Lake Washington and the Green-Duwamish populations are part of the Puget Sound Chinook evolutionarily significant unit (ESU).

Bull trout are listed by the USFWS as threatened in Puget Sound. Bull trout have been identified on several occasions within the Lake Washington watershed; however, no reproductive habitat or reproducing populations of anadromous bull trout are known to be present. The Lake Washington Ship

Canal (Alternatives 1.1.1, 1.1.1(s), 1.1.2, and 1.2) may occasionally be used as a migratory corridor by adult or subadult bull trout produced in other watersheds. The Green Line alternative crossing sites do not provide habitat likely to attract bull trout. Bull trout have been identified in the Green River but there does not appear to be a reproducing population within the basin near the potential Green Line bridge crossing.

Several bull trout have been observed in recent years in the Duwamish River (Taylor 2003 personal communication) upstream from Alternatives 6.1 and 6.2. The observed individuals are most likely anadromous bull trout from other basins that have entered the Green-Duwamish River from Puget Sound. Individual bull trout may at times pass the project site (Alternatives 6.1 and 6.2), but it is unlikely that there is sustained presence of bull trout at this location.

Bald eagles most likely forage at times near the Ballard Bridge (Alternatives 1.1.1, 1.1.1(s), 1.1.2, and 1.2), but the area provides little favorable habitat for eagles at present due to intense human activity throughout the area surrounding the location together with the scarcity of perch trees. Bald eagles have been observed perched in the large Sequoias and cedar trees just north of the Key Arena near the Seattle Center (Glowacki 2003 personal communication). Bald eagles do forage within the Duwamish River area (Alternatives 6.1 and 6.2), including the project site. It is likely that the eagles fly over the site, but few existing features of the site or its immediate surrounding area provide specific features likely to be attractive to bald eagles. The Pigeon Point area has trees sufficiently large to provide perch habitat for bald eagles, but none of the trees show evidence of use by bald eagles based on a site inspection by a biologist in spring 2003 (Lawson, Parametrix, Inc. 2003). Table 4.15-6 provides a summary of ESA listed and Candidate Threatened Species.

Table 4.15-6. Summary of ESA Listed and Candidate Threatened Species

Common Scientific	ESA Status ¹	Life Stages Considered	Habitat functions along Green Line alignment
Chinook salmon <i>Oncorhynchus tshawytscha</i>	T	All freshwater phases	Duwamish Waterway: juvenile migration and rearing, adult migration. Ship Canal: juvenile migration and rearing, adult migration.
Bull trout <i>Salvelinus confluentus</i>	T	All freshwater phases	Duwamish Waterway: subadult and adult migration and rearing. Ship Canal: subadult and adult migration and rearing
Coho salmon <i>Oncorhynchus kisutch</i>	Candidate	All freshwater phases	Ship Canal: juvenile migration Duwamish Waterway: yearling and adult migration Longfellow Creek: juvenile migration
Bald eagle <i>Haliaeetus leucocephalus</i>	T	Resident & Wintering	Duwamish Waterway, Elliot Bay shoreline, Ship Canal: foraging. Seattle Center area: roosting

¹ T = threatened.

Essential Fish Habitat

The Magnuson-Stevens Act requires the evaluation of proposed federal actions to include impacts to habitat of commercially managed fish populations. EFH has been defined for the purposes of the Magnuson-Stevens Act as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (NMFS 1999b). NMFS has further added the following interpretations to clarify this definition:

- “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate.

- “Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- “Necessary” means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem.
- “Spawning, breeding, feeding, or growth to maturity” covers the full life cycle of a species.

At each of the alternative Green Line crossing locations, EFH is present for salmon, but the sites do not provide EFH for other EFH species (such as coastal pelagics and groundfish). The Lake Washington Ship Canal (Alternatives 1.1.1, 1.1.1(s), 1.1.2, and 1.2) provides a migratory corridor for salmon produced in the Lake Washington watershed. The Duwamish River (Alternatives 6.1 and 6.2) also provides a migratory corridor for salmon produced in the Green River watershed. NOAA Fisheries has recently defined EFH for Pacific Coast salmonids, including Chinook salmon, within Amendment 14 to the Pacific Coast Salmon Plan (NMFS 2000c). The important elements of EFH for salmon are (1) estuarine rearing; (2) early ocean rearing; and (3) juvenile and adult migration. Important features of estuarine and marine habitats are (1) adequate water quality; (2) adequate temperature; (3) adequate prey species and forage food; and (4) adequate depth, cover, marine vegetation, and algae in estuarine and nearshore habitats. While limited information exists on the characteristics of habitat that salmon use when they are in marine waters, it is clear that those habitats used during early ocean entry are important. The geographic extent of EFH for marine salmon includes all waters from mean high water to 60 km (35 miles) offshore north of Point Conception, California (NMFS 2000c).

Estuarine habitat used by juvenile salmon is expected to include beaches, bays, and inland passages during spring and summer over all bottom types with preferred forage of copepods, euphasids, and amphipods. Dissolved oxygen in the water is lethal at less than 2.0 mg/L and is optimum at saturation. Water temperature may range from 0° to 26°C, but 12° to 14°C is considered optimum (NMFS 2000c).

4.15.2 Impacts

Long term operational impacts that may occur to existing fish, wildlife, and vegetation resources along the Green Line route are discussed in this section. General impacts to habitat (physical and biological conditions) and to specific species are identified where habitat is present along the Green Line route. Differences in impacts among the alternatives are identified where they may occur. Short term impacts that would potentially occur due to construction of the Green Line are discussed in Section 4.17, Construction. Alternatives analyzed in this Final EIS have been modified and further developed from those evaluated in the Draft EIS. Some impacts identified in the Draft EIS have been avoided by these modifications and by the Preferred Alternative.

Potential impacts to fish, wildlife and vegetation resulting from operation of the Green Line would be similar for most alternatives along most of the route. Similar impacts to aquatic habitat and fish resources within the Lake Washington Ship Canal could potentially occur with each of the alternative bridge locations. New support columns would be placed within the waters of the Ship Canal altering the existing habitat conditions as described below. Alternatives for the Ballard Crossing vary primarily in the location at which these impacts would occur. Support structures and construction techniques for the various bridge types will differ somewhat (specifics to be identified in final design of the design-build project). Each alternative would include construction of a temporary trestle over a portion of the Ship Canal outside the navigation channel that would be removed during completion of the bridge (see Section 4.17 Construction).

Impacts to aquatic and riparian habitat at the Duwamish River would be minimized by placing the guideway on top of the West Seattle Bridge with the Preferred Alternative, or spanning the habitat with another alternative. Construction activities at the Duwamish East Waterway crossing would include

construction of a temporary trestle or sectional barge over a portion of the waterway. These structures would be removed following reinforcement of the existing bridge piers (see Section 4.17 Construction). Impacts to the northern edge of the greenbelt at Pigeon Point would be avoided by the Preferred Alternative, which would remain above the West Seattle Bridge at this location. Alternative 6.1.2 would pass through the forested area at the lower edge of the Pigeon Point hillside. Impacts to Longfellow Creek would be avoided with the Preferred Alternative by crossing the stream where it is in a culvert under a street. Only Alternative 6.1 would cross the open channel of Longfellow Creek. Several alternatives including 6.1, 6.2, 6.4, and 6.4(s) could impact the periphery of the small wetlands within the Longfellow Creek riparian area. Only the Delridge 1, 1A, and 2 station alternatives would overlap the periphery of the Longfellow Creek riparian zone at the location where the stream enters the long culvert discharging to the Duwamish West Waterway.

Street trees and other planted vegetation present at several locations along the Green Line route would potentially be removed or trimmed with the various alternatives depending on final design and placement of support structures as well as tree height. Within the Seattle Center, some trees would potentially be removed or altered by each of the alternatives. The specific trees that might potentially be removed would vary with each alternative. Potential removal or alteration of street trees is discussed below for each segment of the Green Line route. Trees that must be removed would be replaced where possible as part of a landscaping plan developed by SMP to integrate guideway and station design with the surrounding environment and to mitigate any impacts caused by the removal or trimming of trees or other vegetation.

4.15.2.1 Operational Impacts

Analysis shows that the Green Line guideways, bridges, and stations would have limited impacts. Operation of the Green Line is not likely to affect aquatic or terrestrial fauna and flora along most of the corridor. The monorail is a mode of transportation that generates minor amounts of contaminants and does not have air emissions along the corridor. The same types of routine maintenance of the bridge structures would occur with each of the alternatives. These activities will include repair and painting as required (see Appendix T, Water Resources Backup Information in the Draft EIS). These activities would be essentially the same as maintenance activities for other bridges, except that the monorail bridge would be of relatively simple construction, requiring relatively little maintenance. Best management practices for cleaning, painting, and repair of structures over the waterways would be followed to minimize operational impacts (see Section 4.14, Water). Identified bridge types are likely to differ only slightly in the degree but not the type of impacts to fish, wildlife, and vegetation. No lighting that is likely to affect birds and wildlife would be present on the guideway and bridges. Bridges would have appropriate lighting for navigation purposes. See Section 4.5, Visual Quality and Aesthetic Resources, for discussion of lighting and potential impacts resulting from guideway and station lighting. No direct lighting of water or terrestrial habitat areas is anticipated during operation of the Green Line.

Long term operational impacts to plants and animals would occur in the Ballard and Interbay Segments, and potentially as well as in the West Seattle Segment, as described below. Operational impacts in the Queen Anne/Seattle Center/Belltown, Downtown, and SODO Segments would be minor because of the limited habitat present in these areas together with the minor change in noise and human activity with the Green Line.

Street trees would be permanently removed from some locations where support columns or stations are placed depending on final design. The approximate quantities and species are described below for each Green Line segment description. Please refer to Appendix W, Tree Survey Backup Information, for a list of trees potentially affected by the Green Line alternatives. Segments 1 and 2: Ballard and Interbay/Magnolia Segments

Ballard Crossing Alternatives

Potential impacts to fish and wildlife would occur within this segment as a result of the Lake Washington Ship Canal crossing. At the Ballard Crossing, the Preferred Alternative (1.1.1) would have a horizontal dual beam configuration located between 40 and 120 feet west of the existing Ballard Bridge using a box girder structure. Alternative 1.1.2 (Far West Bridge) would place a similar bridge about 200 feet west of the existing Ballard Bridge. Alternative 1.2 (East Bridge) would place the alignment about 100 feet east of the existing Ballard Bridge using a box girder, arch, or cable-stayed structure. Alternative 1.1.1(s) would follow the alignment of Alternative 1.1.1 but with a single beam box girder bridge.

The narrow profile of the Ballard Crossing, together with its height, which would range from 120 to 125 feet above the water, would prevent significant shading impacts to the aquatic habitat of the Ship Canal, based on observations under roadway bridges of similar height and greater width. See Section 4.5, Visual Quality and Aesthetic Resources, for a discussion of lighting and potential impacts.

The slender guideway and support columns of the Ballard Crossing would provide only slight additional shading of the Ship Canal's aquatic habitat (see Chapter 3 for maps), which supports exotic aquatic vegetation. Exotic macrophytes (eurasian water milfoil) were observed growing in shallow areas adjacent to the Ballard Bridge during a site visit (July 2003). The height and narrow width of the guideway on the Ballard Crossing would avoid a detectable impact to photosynthetic activity in the water or at the shoreline. Similar vegetation currently grows under the SR 520 bridge in the Arboretum area where the much wider bridge is only 6-8 feet above the water. The new columns would create narrow bands of moving shade that are unlikely to have any measurable impact on fish or aquatic habitat. See Section 4.5, Visual Quality and Aesthetic Resources, for discussion of lighting and potential impacts.

The water column and sediment at the column locations do not provide unique habitat or habitat functions. This area functions as a migratory corridor for young and adult salmon that migrate from and to Lake Washington. Resident fishes are likely to be associated with shorelines or structures in this vicinity. Juvenile salmon migrating through the area are most likely either shoreline-oriented or occupy near-surface water throughout the general cross section of the Ballard Crossing. The contaminated sediment in the area does not provide particularly good conditions to support fish or invertebrate species. The shorelines are generally a mix of vertical man-made substrates and over-water pier aprons. Near-shore areas are commonly dredged to about six to ten feet deep to the bottom of the steep shorelines of pier edges. Support columns are planned to be at locations generally ten feet deep or deeper.

New structures and substrate at the Ballard Crossing location would provide new hard substrate for diatom production and potentially a slight increase in structure habitat for predator species such as smallmouth bass. This could result in a slight increase in predation of juvenile salmonids by bass, although due to the abundance of such habitat structures in the area, any increase is unlikely to be measurable. Any new structures in the water would be at least 50 feet away from the shoreline where juvenile salmon are most likely to migrate. The specific location and characteristics of the structures would be determined by final design. As described above, the number and size of in-water support columns varies with bridge type, span length, and location.

Ballard Crossing: Preferred Alternative

The Preferred Alternative (Alternative 1.1.1 – West Bridge) would locate the Ballard Crossing immediately west of the Ballard Bridge across the Ship Canal. Operational impacts would be produced primarily by the presence of the support columns within the aquatic habitat adjacent to the existing Ballard Bridge. Also minor impacts would occur by the release of small amounts of metals and oils from the monorail vehicles. The guideway pollutant loading analysis shows very little increase in metals from operation of the monorail (See Section 4.17).

The Preferred Alternative would be supported by three main span support columns and up to eight approach support columns. The main span support columns would be in deeper water near the navigation channel. Each main span column would be about 12 feet in diameter from the sediment surface through the water column. Approach span columns would be cylinders about 11 feet in diameter. These main and support columns may therefore cover up to 1,200 square feet of bottom area, which is a small fraction of the over 250 acres of benthic habitat in the general vicinity of the Ballard Crossing. Since the larger 48 foot by 48 foot footings for each column will be constructed below the mud line, the larger footprint of the footings will not permanently displace benthic habitat. The total of about 1,200 square feet of benthic habitat is a small amount of the roughly 250 acres of benthic habitat available in the general vicinity of the Ballard Crossing location.

These support columns would add to the existing piles and other structures of the Ballard Bridge, fender protection system, and mooring structures at and adjacent to the project site. The new concrete surface area within the water column would be a total of about 5,000-6,000 square feet, but there would be no interior or shaded space within the support column. The volume of water present in the ship canal would be reduced slightly by the support columns (about 500 to 600 cubic yards).

The presence of new columns within the water of the Ship Canal potentially provides additional habitat for smallmouth bass. However, the large solid surfaces of the support columns would not provide desirable habitat for smallmouth bass. The presence of a large amount of existing pile structure within the immediate vicinity of the potential crossing locations minimizes the potential impact to the smallmouth bass population. A potential increase in the bass population could increase predation on young salmon migrating from Lake Washington to the Hiram M. Chittenden Locks. The physical characteristics of the columns together with the absence of a change in the prey base sustaining smallmouth bass would likely avoid an increase in the bass population. Keeping the columns more than 50 feet waterward from ordinary high water would minimize the potential impact of these structures if the bass population were to increase. Juvenile Chinook salmon migrating through the Ship Canal appear to follow the shorelines rather than migrating directly through open water (Paul DeVries, 2004 Greater Lake Washington Chinook Workshop, February 2, 2004)

See Section 4.5, Visual Quality and Aesthetic Resources, for discussion of lighting and potential impacts. Light levels at the water surface would not be sufficient to alter behavior of fish. Exotic macrophytes (eurasian watermilfoil) currently grow in some of the shallow areas adjacent to and under the Ballard Bridge. No lighting of the bridge would be provided that would affect the aquatic habitat of the Ship Canal. Lighting on the Green Line bridge would be restricted to low-intensity obstruction lighting to meet air and marine navigation requirements.

The Muckleshoot Indian Tribe conducts commercial and ceremonial-subsistence fishing throughout the Lake Washington Ship Canal, Lake Union, and Lake Washington. Other federally recognized tribes also fish in the Ship Canal and the Lake Washington system. The type of fishing (including method), area open to fishing, and the season of fishing are determined by tribal fishing regulations that change from year to year. Tribal fishers use the 14th Ave. NW boat ramp, Shilshole Marina, and other facilities within the Ship Canal and Lake Washington for access to these waters. Fishing in these waters is open to any enrolled Muckleshoot Tribe member with the number of fishers participating in fishing within the Ship Canal varying from year to year.

New columns supporting the Green Line Bridge over the Ship Canal have the potential to reduce a portion of the Ship Canal available to Muckleshoot Tribe fishers. The Preferred Alternative would place support columns immediately west of the Ballard Bridge. This area is currently occupied on the north side by several boathouses at the shoreline with about 100 feet of open water to the fender system for the Ballard Bridge. The vessels moored at the shoreline boathouses currently use the open water. No support columns would be added to the navigation channel. South of the navigation channel the new support

columns would be constructed in an area currently occupied by a marine railway, boat repair facility and support dock. It is assumed that the existing current shoreline and water uses at the Green Line crossing restrict the Tribe's fishing access at the site. The proposed Green Line bridge could continue to or further restrict fishing access adjacent to the west side of the Ballard Bridge.

As described above in Section 4.15.1.1, SMP has initiated government-to-government consultations with affected tribes, including the Muckleshoot Tribe and the Suquamish Tribe, for purposes of identifying potential effects of Green Line operations on treaty fishing rights. SMP, in cooperation with the tribes, is currently developing information on tribal fishing patterns and activities. This information will enable SMP to tailor operations in a way that avoids or minimizes impacts to tribal fishing activities.

Noise generated by operation of the Green Line would be intermittent noise within the range of ambient road noise at the Ballard Bridge location (see Section 4.7, Noise and Vibration). Ambient sound levels measured along 15th Avenue NW in the Ballard Bridge vicinity have hourly values of 57 to 72 dBA with the maximum near 100 dBA. Operation of the Green Line is predicted to produce sound levels of 51 to 74 dBA. No noise or vibration has been predicted for the Green Line that would be transmitted to the water where the salmonids would potentially be affected. This is partially due to the vibration damping effect that the tall bridge columns would have.

Street Trees – Ballard Segment

Street trees potentially removed or trimmed with Segment 1 alternatives are summarized in Table 4.15-7. Substantial numbers of street trees would be removed with Alternatives 1.1 and 1.1(s) (Preferred Alternative), but not with Alternative 1.2. For a detailed survey of trees along the Green Line alternative alignments, please see Appendix W, Tree Survey of the Draft EIS.

Table 4.15-7. Segment 1 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 1.1 West Side 15 th Ave NW	red maple, linden, sweet gum	140-160	10-50
Alternative 1.1(s) West Side 15 th Ave NW, single beam	Same as Alt. 1.1	Same as Alt. 1.1	Same as Alt. 1.1
Alternative 1.2 (Center of 15 th)	linden	12 near Ballard Swimming Pool 3 Ballard Bridge	10-15

Street Trees – Ballard Segment – Preferred Alternative

The Preferred Alternative in the Ballard Segment (Alternative 1.1(s)) would remove or trim 140 to 150 trees along the west side of 15th Avenue NW to accommodate the guideway and columns. This would be a greater impact than for Alternative 1.2, which would travel above the center of 15th Avenue NW. Trees would be replaced per SMP's Design Guidelines.

Street Trees- Interbay/Magnolia Segment

Street trees would be removed or trimmed for any Segment 2 alternative as summarized in Table 4.15-8. In addition, Alternative 2.1 would potentially remove trees in two small greenbelts along the Emerson-15th Avenue N interchange.

Table 4.15-8. Segment 2 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 2.1 West Side 15 th Ave NW/center Elliott	red maple, hornbeam, zelkova, purple plum, sweet gum	110-120	10-50
Alternative 2.1(s) West Side 15 th Ave NW/center Elliott, single beam	Same as Alt. 2.1	Same as Alt. 2.1	Same as Alt. 2.1
Alternative 2.2 Center of 15 th NW/west side Elliott	Same as Alt 2.1	all 15 th Ave NW 15 trees W Nickerson	Same as Alt 2.1

In addition the Dravus 1 (16th) station alternative and platform would remove several trees near the grocery store building (Figure M-17, of Appendix M of the Draft EIS). The Dravus 1B (Barrett) station alternative would remove several more trees than with only the guideway crossing the area.

Interbay Operations Center. At the P-Patch near the Interbay Operations Center, street-edge vegetation could be removed or trimmed for columns, but the tree border inside the P-Patch is not expected to be affected.

Street Trees – Interbay/Magnolia - Preferred Alternative

Through the Interbay/Magnolia Segment, the Preferred Alternative would follow the alignment of Alternative 2.1. It would require the removal or trimming of more trees than Alternative 2.2, but trees would be replaced per SMP's Design Guidelines.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Street Trees Queen Anne/Seattle Center/Belltown Segment

Operation of the Green Line would require control of vegetation height under the guideway (see Chapter 3 for maps) for each alternative as summarized in Table 4.15-9. Trees would be trimmed to maintain clearance for the guideway. Alternative 3.1 is the Preferred Alternative for Segment 3.

Table 4.15-9. Segment 3 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 3.1 Seattle Center/Republican	London plane, purple plum, crabapple, sweet gum	34 W Harrison 40-50 Seattle Center	20-50
Alternative 3.1.2 Around EMP	London plane, honey locust	20 London plane 15 honey locust	Same as Alt. 3.1
Alternative 3.1.4	London plane	3 Fifth & Broad	60-70
Alternative 3.2 Mercer	London plane, purple plum, scarlet oak, crabapple sweet gum, madrone	34 W Harrison 16 Warren Ave. 30-40 Mercer	20-80
Alternative 3.2.2	London Plane, purple plum, scarlet oak, crabapple sweet gum,	34 Harrison 16 Warren Ave. 55- 60 Fifth Ave.	20-80
Alternative 3.3 Thomas	London plane, purple plum, crabapple, sweet gum, katsura trees, Norway maple	35-40 W Harrison 100 Thomas St.	20-50
Alternative 3.5 Second/Denny	London plane, purple plum, crabapple, sweet gum, red leaf maple	33 W Harrison 15 Denny Way 30-40 First-Denny	20-50

Within the Seattle Center Alternative 3.1 about 20 mature London plane trees would be removed on the south side and 24 trees could require trimming on the north side. The mixed tree border at Memorial Stadium would likely be affected by construction of columns. Alternative 3.1.2 could remove the honey locust row between the stadium and Fun Forest and the rows of London plane trees along Thomas Street.

The Southwest station for Alternative 3.1.4 at Fifth and Broad 1A would remove three 60- to 70-foot tall London plane trees. The Belltown 1 (Center-West) station alternative would remove a few mature street trees on the west side of Fifth Avenue

Segment 4: Downtown/Pioneer Square Segment

No habitat supporting fish, wildlife, or vegetation occurs along the Downtown Segment for any of the Green Line alternative alignments, except for street trees, which would be removed or trimmed in some places to provide clearance for Green Line guideways.

Street Trees Downtown/Pioneer Square Segment

Alternatives along the west and east sides of Second Avenue (4.1, 4.2) would remove or trim more street trees (Table 4.15-10) than alternatives within the roadway (4.3, 4.4), which would only remove street trees at station locations. The Preferred Alternative for the Downtown Segment is Alternative 4.1 (West of Second) with Alternative 4.1.2 as the transition from Fifth Avenue. The large redwood near the corner of Fourth Avenue and Stewart Street would potentially be affected by the Preferred Alternative, but this impact could likely be avoided through design.

Table 4.15-10. Segment 4 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 4.1 West Side Second Ave	red maple, London plane, linden, honey locust	56 Second Ave 1 redwood	40-50 80
Alternative 4.2 East Side Second Ave	Same as Alt. 4.1	80-85	40-50
Alternative 4.3 Center of Second	Same as Alt 4.1	21 Second Ave	40-50
Alternative 4.4 East of Center of Second with Crossover	Same as Alt 4.1	21 Second Ave	40-50
Alternative 4.4 Center of Second	Same as Alt 4.1	Only at station locations	40-50

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

No habitat supporting fish, wildlife, or vegetation occurs along the SODO Segment for any of the Green Line alternative alignments. Table 4.15-11 indicates the potential number of trees expected to be removed or trimmed.

Table 4.15-11. Segment 5 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 5.1.1	red maple	20-30	15-40
Alternative 5.1.2	red maple	20-30	15-40
Alternative 5.2	red maple	10-15	30-40
Alternative 5.2(s)	red maple	10-15	30-40

Segment 6: West Seattle Segment

The West Seattle segment has habitat at the Duwamish River, Pigeon Point and Longfellow Creek that could potentially be altered by one or more alternatives. Street trees also would be potentially removed or trimmed with one or more alternatives. The potential impacts to habitat, wetlands, and street trees are discussed below separately for each area within the West Seattle segment.

Habitat Impacts

Duwamish River. No significant impacts to fish, wildlife, or vegetation are anticipated to result from the operation of any alternative for crossing the East and West Waterways of the Duwamish River. None of the alternatives would affect the tribal fishery conducted throughout both the East and West Waterways of the Duwamish River. In the Duwamish River, tribal fishers launch vessels from the boat ramp, which is adjacent to the Tribe's property that supports fishing activities outside the area potentially affected by either alternative. None of the alternatives would alter the existing conditions. Please see Section 4.17 for a discussion of impacts related to the potential use of a temporary trestle in the East Waterway.

Pigeon Point. Alternatives 6.1.1, 6.2, 6.3(s), and 6.4 would not alter the habitat at Pigeon Point. Operation of Green Line Alternative 6.1.2 would initially remove about an acre of vegetation and require control of vegetation height in the Pigeon Point greenbelt under and adjacent to the guideway. Trees would be trimmed to maintain clearance for the guideway and maintenance access. A pruning plan would be developed in cooperation with the City of Seattle for operation of the Green Line if this alternative were selected. This plan would be part of a restoration/mitigation plan for construction of the Green Line through the Pigeon Point greenbelt (see Construction Impacts Section 4.17.16).

Alternatives 6.1.1, 6.2, 6.3(s), and 6.4 would avoid noise impacts to the Pigeon Point area by placing the source of Green Line noise over the West Seattle Bridge roadway. With the guideway over the existing roadway, the sound levels generated by Green Line will be within the range of noise generated by the West Seattle Bridge that is located over the edge of the vegetated area. Noise generated by the operating Green Line would be in the range of 51 to 65 dBA. Operation of the Green Line near the Pigeon Point habitat with Alternative 6.1.2 would potentially produce impacts through noise and the presence of the guideway within the greenbelt (see Chapter 3 for maps). Alternative 6.1.2 would place the source of the Green Line noise within the habitat resulting in substantial sound levels 51 to 75 dBA (see Section 4.7, Noise and Vibration) potentially within a few feet of birds and wildlife. However, ambient noise levels in this area are relatively high due to the existing West Seattle Bridge immediately adjacent to the existing trees.

Longfellow Creek. No significant impacts to Longfellow Creek or its riparian area are anticipated with any alternative. The Green Line would span Longfellow Creek, avoiding direct impacts to in-water aquatic resources with all alternatives. Operation of the Preferred Alternative (6.3(s)) would avoid impacts to Longfellow Creek by not crossing the open stream channel. Alternative 6.1 would cross the stream channel south of SW Andover Street, but would not have any structures in or near the channel. The narrow guideway about 70 feet above the stream would have less impact on the stream habitat than the three foot bridges constructed over this open channel portion of the stream in recent years.

Operation of the Green Line with a station at Delridge would potentially attract more human activity to the Longfellow Creek and trail area, which could increase litter and other impacts. Increased human use could negatively impact spawning salmon if access to the stream shorelines is allowed. If increased human disturbance should become an issue, planted vegetation could limit access to the stream vicinity.

Wetlands

Two wetlands within the Longfellow Creek riparian area would potentially be affected by several alternatives, but not by the Preferred Alternative. No alternative would fill or disturb either wetland A or B identified in West Seattle. Only Alternatives 6.1, 6.44, and 6.4(s) have potential impacts to these wetlands or their buffers. Impacts to the buffers of Wetlands A and B are expected to be minor. Alternative 6.1 could potentially impact a portion of the buffer of Wetland A, and Alternatives 6.4 and 6.4(s) could potentially impact Wetland B's buffer. If a guideway column is located in a wetland buffer area, mitigation could be required pursuant to City of Seattle or Department of Ecology regulations. Since the column spacing can span distances up to 120 feet without need for special structures, it is expected that at most a single 12-foot diameter column would be located within these buffers. As a result, the total area of the buffer impact for each of these alternatives would likely not exceed 115 square feet.

Street Trees West Seattle Segment.

Table 4.15-12 summarizes street trees to be removed or trimmed within Segment 6. In addition Alternative 6.1.2 would remove about an acre of mature red alder and other trees from the greenbelt at Pigeon Point. Alternatives 6.2.1, 6.2.2, 6.3(s), 6.4, 6.4(s), and 6.5 would each remove or trim many of the same trees southeast of Alaska Junction. The major differences among these alternatives are between the West Seattle Bridge and the Alaska Junction.

Table 4.15-12. Segment 6 Street Trees Potentially Removed or Trimmed

Alternative	Tree Species	Number	Size (ft)
Alternative 6.1 / 6.1.1 past Pigeon Pt.	linden, red maple, hornbeam, zelkova, purple plum, sweet gum, fruit trees	90-100	20-70
Alternative 6.1 / 6.1.2 to Pigeon Pt	same as 6.1	90-100 + redwood grove at Pigeon Pt.	20-70
Alternative 6.1.2(s) single beam	same as 6.1	90-100 + redwood grove at Pigeon Pt.	20-70
Alternative 6.2.1	same as 6.1	140-180	20-70
Alternative 6.2.2	same as 6.1	120-130, no park buffer trees	20-70
Alternative 6.3(s)	same as 6.1	50-60	20-70
Alternative 6.4 and 6.4(s)	same as 6.1	80-90	20-70
Alternative 6.5	same as 6.1	90-100	20-70

Under Alternative 6.2 (West Seattle II), impacts along SW Avalon Way would be similar to those generated by Alternative 6.1.

Alternative 6.2.1 would remove or trim approximately 110 lindens and 10 maples. The Avalon 2A (35th) station alternative associated with this alignment would remove the 40- to 50-foot-tall screen of mature conifers at the edge of West Seattle Stadium Park.

The Avalon 2B station alternative would not remove of trees or encroach on parkland.

Under Alternative 6.3(s) (Delridge North Subsegment), no street trees would be removed with this alternative.

Under Alternative 6.4 (Andover/Yancy Subsegment), the Delridge 1A (26th) station could have minor habitat impacts on the Longfellow Creek greenbelt because the station and guideway would be aligned over the buffer at the culvert entrance just south of SW Andover Street. The Delridge 1A option for this alternative would avoid structures within the Longfellow Creek greenbelt by crossing the stream next to SW Andover Street where the stream is contained within the long culvert. No street trees would be removed with either option of Alternative 6.4.

Street Trees - Preferred Alternative West Seattle Segment

For the Duwamish Crossing, the Preferred Alternative – which would remain on the West Seattle Bridge past the Pigeon Point greenbelt – would not remove or trim any trees or vegetation. The Preferred Alternative, north of Nucor through the Delridge area, would also not remove or trim any trees or vegetation. In the Avalon area, the Preferred Alternative would avoid impacts to the tree buffer at the edge of West Seattle Stadium Park. Along California Avenue SW, the Preferred Alternative along the west side of the street would require the removal of approximately 100 trees. This would be more than with a center alignment along California, but street trees would be replaced per SMP's Design Guidelines.

4.15.2.2 No Action Alternative

The No Action Alternative would result in increased demand for other transportation facilities along the same corridor that may require other structures within the same habitats at some undefined time in the future. The existing corridor is served exclusively by roadways for automobile and bus vehicles to transport passengers among the various locations along the route. Roadways and bridges currently exist along the corridor, along with extensive commercial, industrial, and residential development. These transportation activities would continue and increase in the absence of the Green Line. No street trees would be removed under the no action alternative.

4.15.3 Mitigation

SMP will mitigate, as appropriate, for lost habitat or lost habitat functions resulting from construction of the Green Line guideway and its stations. Long-term operational impacts to aquatic resources would be limited to those resulting from construction of new support columns at the Ship Canal crossing with each of the alternatives. As discussed in Section 4.17.16, SMP is working to avoid and minimize in-water impacts by selecting the narrower crossing alternatives and maximizing the span between support columns. The new in-water structures for the Ballard Crossing would remove existing aquatic habitat, likely requiring mitigation. Potential mitigation measures are identified below, and specific mitigation commitments are discussed in Chapter 5. SMP is working with resource agencies, the City of Seattle, and other entities to continue work to develop a package of appropriate mitigation measures.

The Preferred Alternative avoids impacts and the need for mitigation at most locations. Impacts for which mitigation would be developed include the Ballard Crossing, and vegetation and street tree removal with the Preferred Alternative.

The Green Line alternatives would each potentially alter natural terrestrial habitat or habitat functions at only a few locations where impacts cannot be avoided. These altered habitat conditions could require compensatory mitigation to improve habitat functions at the site or at adjacent locations. Potential mitigation would be commensurate with the type and extent of impacts.

4.15.3.1 Segments 1 and 2: Ballard and Interbay/Magnolia Segments

Mitigation would be required for lost habitat or lost habitat functions resulting from construction of new in-water structures for the Ballard Crossing. Depending on the bridge type that would be constructed, the Green Line bridge over the Lake Washington Ship Canal would be supported by six to eleven columns that would remove biological production from the sediment and water column occupied by the columns.

The Preferred Alternative (1.1.1 – West Bridge) would place three mainspan support columns and six approach support columns within the Ship Canal. Alternative 1.1.2 would have about the same number of columns as Alternative 1.1.1, and Alternative 1.2 would likely have more support columns (see Chapter 3, Project Description). Mitigation for these impacts to existing, degraded habitat and habitat functions could be required as part of permit conditions.

Existing biological production at the potential support column locations is limited by the physical and chemical conditions of the column locations. Shoreline impacts would be avoided by keeping columns at least 50 feet waterward of the Ordinary High Water line.

The Ship Canal is a constructed habitat that has been degraded by chemical contamination and major physical modification to support intense commercial use. Removal of offshore benthic and water column habitat within the Ship Canal could be mitigated by construction of rare habitat supporting other functions or by improvements in the general habitat of the Ship Canal.

Mitigation measures are being considered to improve habitat functions within the currently degraded conditions of the Ship Canal. Potential mitigation measures that would be evaluated with permitting and natural resource agencies include: The following are possible mitigation options and

- Removal of the creosote treated timber fender system protecting the Ballard Bridge and reconstruction with non-toxic rubber, steel, or concrete structures (general habitat improvement by toxics removal).
- Shoreline habitat improvement by removal of man-made structures, construction of moderate gradient slopes, and sand-gravel substrate in shallow water less than 6 feet deep (improved habitat supporting migrating juvenile salmon).
- Reconstruction of some shoreline areas to restore more gradual slopes and natural substrates, such as sand and gravel to provide new gently sloping shoreline habitat.
- Excavation of uplands one or both shorelines under the proposed monorail bridge over the Ship Canal to produce new shallow-water habitat that is missing along most of the Ship Canal shoreline (new habitat supporting migrating juvenile salmon).
- Reconstruct natural shoreline characteristics at another location (not yet identified), along the Ship Canal or elsewhere in the same general area, if approved by the resource agencies and land uses provide an opportunity.
- Participation in a habitat improvement project proposed by another entity for the Ship Canal or the biological resources supported by the Ship Canal habitat (improved survival conditions for juvenile salmon).

These options are currently being explored in the general vicinity of the bridge crossing locations; however, other locations along the Ship Canal are likely to be of equal value to the biological resources.

4.15.3.2 Segment 3: Queen Anne/Seattle Center/Belltown Segment

Mitigation for removal of landscaping and street trees could include replacement of the vegetation removed, if appropriate. This would be decided on a case-by-case basis depending upon the type and location of plantings affected. Selection of the Preferred Alternative would require removal of some existing trees within the Seattle Center. Removal of any vegetation, including street trees and trees within the Seattle Center could be mitigated by replanting appropriately-sized trees, planting larger trees at new locations, or transplanting trees as appropriate for the specific conditions at various sites within this area.

4.15.3.3 Segment 6: West Seattle Segment

Duwamish River East Waterway. The Preferred Alternative for the Green Line avoids impacts and the need for mitigation at the Duwamish River and Longfellow Creek, crossings by spanning the streams and avoiding inwater structures. Some temporary construction impacts to the Duwamish East Waterway from placement of overwater and inwater structures are discussed in Section 4.17.16. The guideway would be located over the West Seattle Bridge avoiding the need for mitigation in the Duwamish River.

Pigeon Point Greenbelt. Alternative 6.1.2 would remove trees and other vegetation within the Pigeon Point Greenbelt (see Chapter 3, Project Description). This alternative would place the guideway through a 400-foot length of vegetation, with two or three support columns within the vegetation area (assuming spacing of 155 to 185 feet). Construction would potentially remove all existing vegetation along the 400-foot corridor within 50 feet to either side of the centerline. This impact could be avoided by selection of Alternative 6.1.1 or 6.2. Selection of the Preferred Alternative 6.1.1 (s) would avoid any alteration of existing vegetation at the north end of Pigeon Point.

If Alternative 6.1.2 is selected, mitigation for removal of the Pigeon Point vegetation could be provided by replanting in the Pigeon Point area after construction and/or planting similar vegetation at another location in the same general vicinity as Pigeon Point.

Longfellow Creek. In the Delridge area, alternatives have been revised since the Draft EIS to avoid impacts to Longfellow Creek aquatic habitat. In the Delridge area, the Preferred Alternative 6.3 (s) would avoid any alteration of existing aquatic and riparian habitat associated with Longfellow Creek, eliminating any need for mitigation. Alternative 6.1 would place the guideway near Andover Street SW where the creek is within the long culvert that discharges to the Duwamish West Waterway. The Delridge Station for Alternative 6.1 would overlap the edge of the riparian zone of the downstream end of the open channel of Longfellow Creek. Impacts to Longfellow Creek would be avoided by the alignment of the Preferred Alternative, which would locate the guideway north of the Nucor steel plant along the approach to the West Seattle Bridge (Alternative 6.3(s)).

In the Delridge area, the Preferred Alternative 6.3 (s) would avoid any alteration of existing aquatic and riparian habitat associated with Longfellow Creek, avoiding any need for mitigation. Alternatives 6.2, and 6.4 would also avoid alteration of the Longfellow Creek habitat avoiding a need for mitigation. With Alternative 6.1, vegetation adjacent to Longfellow Creek would be removed from the site of the support column on the west side of Longfellow Creek as well as within the Station footprint east of Longfellow Creek. The support column on the east side of Longfellow Creek would be within the Delridge Station site. The location of the support column on the west side of Longfellow Creek would be determined during final design. The column would occupy an area of about 12 by 12 feet, removing whatever vegetation is present at the specific location selected west of the stream. Mitigation could be provided by removal of introduced vegetation (Himalayan blackberries, etc.) and replanting with dense native vegetation. Dense plantings of vegetation could be provided to reduce human use of the riparian areas and provide canopy cover of the stream in the spawning area at and near the Green Line crossing site. Improvements to the creek and riparian area, including landscaping, could be incorporated into the design for the Delridge 1 and 2 station alternatives.

With Alternative 6.1 the guideway would be at a sufficient height and sufficiently narrow width over Longfellow Creek to avoid detectable impacts to aquatic habitat and the need for mitigation. With all other alternatives, impacts to Longfellow Creek and the need for mitigation would be avoided by not crossing the open channel of the stream. At Longfellow Creek, mitigation for any perceived impact could include additional habitat improvement measures to or along the stream channel or limitations to human access near the Green Line crossing.

Wetlands. Locating the mitigation for impacts to wetlands or buffers in proximity to the impact is highly desirable. Potential mitigation areas are available near Alternatives 6.1, 6.4, or 6.4(s) adjacent to Longfellow Creek. While the western buffer of Longfellow Creek has been enhanced, the eastern buffer is highly disturbed. Some trash has been dumped along the creek, and the vegetation is dominated by invasive not-native species. Forest cover is present only around Wetland B.

Potential mitigation in this area could consist of trash and debris clean up from the buffer, or removal of undesirable non-native species such as Himalayan blackberry and English ivy, followed by replanting with desirable native species that would provide forage for wildlife and cover for Longfellow Creek in addition to reducing the potential for erosion along the creek.

4.15.4 Significant Unavoidable Adverse Impacts

There are few significant unavoidable adverse impacts to fish, wildlife, or vegetation expected to result from construction and operation of the Green Line. Potential unavoidable impacts of a very limited scope associated with the operations of the Green Line could occur at the Lake Washington Ship Canal, Seattle Center, and Pigeon Point locations with one or more of the alternatives being considered.

Lake Washington Ship Canal. The support columns for the Ship Canal Crossing would produce a long-term alteration of a small amount of aquatic habitat with each alternative. Support column footings columns would occupy approximately 400 square feet of area within the canal bottom and be covered by about two feet of clean sediment. With the Preferred Alternative the support columns would occupy approximately 500 to 600 cubic yards of space within the water column. The Preferred Alternative 1.1.1 would place this impact immediately west of the existing Ballard Bridge. Alternative 1.1.2 would place the impact about 200 feet west of the Ballard Bridge and Alternative 1.2 would place the impact about 100 feet east of the Ballard Bridge. The number of support columns (nine to eleven) would be determined during final design. The modest amount of aquatic habitat lost in the Lake Washington Ship Canal through construction of columns could be replaced through mitigation. The new habitat that would be added around the bridge support columns, could increase the potential small mouth bass habitat at the Green Line crossing location. Loss of the small amount of benthic habitat and water column habitat is not anticipated to produce a measurable change in biological populations using the existing Ship Canal habitat.

Pigeon Point. Alternative 6.1.2 could remove a substantial portion of existing vegetation from the Pigeon Point Greenbelt during construction. Although much of the vegetation could be replanted, its height would be limited by the presence and operation of the Green Line with this alternative. The footprint of the support columns could not be replanted. The impact would be avoided by selection of the Preferred Alternative 6.1.1(s) alignment.

4.16 CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) defines cumulative impacts as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (CEQ Regulation 1508.7). Consideration of cumulative impacts has influenced many aspects of the Green Line environmental review process, including scoping, describing the affected environment, developing alternatives, evaluating environmental impacts, and identifying mitigation.

During the scoping process and alternative development, SMP solicited information from agencies and the public to identify other potential future actions, background growth projections, and potential cumulative impacts. SMP received the following information:

- The City of Seattle provided land use plans, transportation plans, neighborhood plans, and lists of known, major land use and transportation proposals.
- WSDOT provided information on planned transportation projects.
- The Port of Seattle provided information on planned Port developments and transportation projects.
- Puget Sound Regional Council (PSRC) provided population and employment growth projections, travel forecasts, and land use projections.
- Other organizations and the public provided information on planned private projects, community values, and concerns.
- Sound Transit provided information on Link Light Rail and Sounder Commuter rail plans.
- King County Metro provided information on bus routes both with and without the Green Line.

4.16.1 Affected Environment

The descriptions of the affected environment in Chapter 4 reflect cumulative impacts of both past and present actions. Aerial photographs, GIS mapping, field reconnaissance, and other techniques were used to identify the existing conditions resulting from past and present actions.

Land use development patterns in recent decades have contributed to adverse impacts on wetlands, water quality, and habitat. Dispersed, low-density growth outside the historical urban areas has dominated development trends in the latter part of the twentieth century, developing more land per capita than in earlier periods of growth. Increased automobile travel and dispersed land use patterns adversely impact environmental quality, including air, noise, visual resources, water quality, and wildlife habitat.

PSRC adopted VISION 2020, an integrated, long-range growth management, economic, and transportation strategy based on a vision of urbanized centers linked by a high-quality transportation system.

4.16.1.1 Future Actions and Projections

This EIS incorporates the effects of potential future actions that could possibly be taken by other agencies and persons. These actions include:

- Population and employment projections, based on PSRC’s model, which projects future land use changes at the local and regional levels.

- Future traffic volumes, vehicle miles traveled (VMT), ridership, and travel times, based on projections of future land use patterns, population and employment growth, and programmed future transportation improvements.

These forecasts incorporate specific programmed transportation improvements and are included in comprehensive and coordinated long-range plans and funding programs that are available to the public. The major transportation improvements that are proposed over the next 10 to 20 years are described in Appendix II (Projects to Consider for Cumulative Effects Analysis), depicted in Figure 4.16-1, and listed below:

- Sound Transit: Central Link Light Rail (NEPA/SEPA Final EIS complete)
- Sound Transit: Everett-Seattle and Tacoma-Lakewood Commuter Rail Lines (NEPA/SEPA Final EIS complete)
- WSDOT, City of Seattle, and Federal Highway Administration (FHWA): Alaskan Way Viaduct and Seawall Project (NEPA EIS currently being prepared)
- WSDOT, Sound Transit, FHWA, and Federal Transit Administration (FTA): SR 520 Bridge Replacement Project (NEPA EIS Notice of Intent issued; publication date uncertain)
- Sound Transit, FTA, WSDOT, and FHWA: Interstate 90 (I-90) Two-Way Transit and High-Occupancy Vehicle (HOV) Operation Project (NEPA/SEPA Draft EIS issued)
- King County Metro Transit, City of Shoreline, and City of Seattle: Aurora Avenue North Multimodal Project

In addition to these projects, the Seattle Popular Monorail Plan that was approved by Seattle voters in 2002 envisioned a citywide monorail system that would include five lines, of which the Green Line would be the first line built. Cumulative impacts associated with the citywide monorail plan were evaluated and analyzed in the Seattle Popular Transit Plan Programmatic EIS. At present, there is no funding available for future monorail lines, and timing of implementation is unknown. The Green Line is a separate, stand-alone project and is not dependent on any other monorail lines to fulfill its purpose and need. Because of the uncertainty regarding the funding and timing for additional potential monorail lines, it is difficult to analyze their impacts with any detail in this EIS for the Green Line.

Most private development projects are not centrally planned, coordinated, and funded, and, until local permit applications are submitted, the plans may not be available for public review. Many specific developments over the next 10 to 20 years therefore cannot be reasonably identified. It is reasonable, however, to forecast changes in land use patterns based on local jurisdiction land use plans, development trends, and population and employment projections. These changes are included through the PSRC long-range forecasting model used for this project. Private development projects with Master Use Permit applications at DPD, public development projects, and City and Port transportation projects are listed below and described in Appendix II. Current knowledge of funding status and construction timelines for the projects are listed; however, the implementation of these projects will depend on the availability of funding (for public projects) and the real estate market (for private projects), both of which are uncertain.

- Private Developers: Potential projects in Ballard, Interbay/Magnolia, Seattle Center/Queen Anne/Belltown, Downtown/Pioneer Square, and West Seattle
- City of Seattle: Elliott/15th Avenue W Multi-modal Transportation Improvement

**Figure 4.16-1
Major Transportation
Projects in Seattle**

Alternatives By Segment

Segment 1: Ballard

- 1.1 - West Side of 15th
- 1.2 - Center of 15th/East Bridge

Segment 2: Interbay

- 2.1 - West Side of 15th/Center of Elliott
- 2.2 - Center of 15th/West Side of Elliott

**Segment 3: Queen Anne/Seattle Center/
Belltown**

- 3.1 - Seattle Center/Republican
- 3.2 - Mercer
- 3.3 - Thomas
- 3.5 - Second/Denny

Segment 4: Downtown

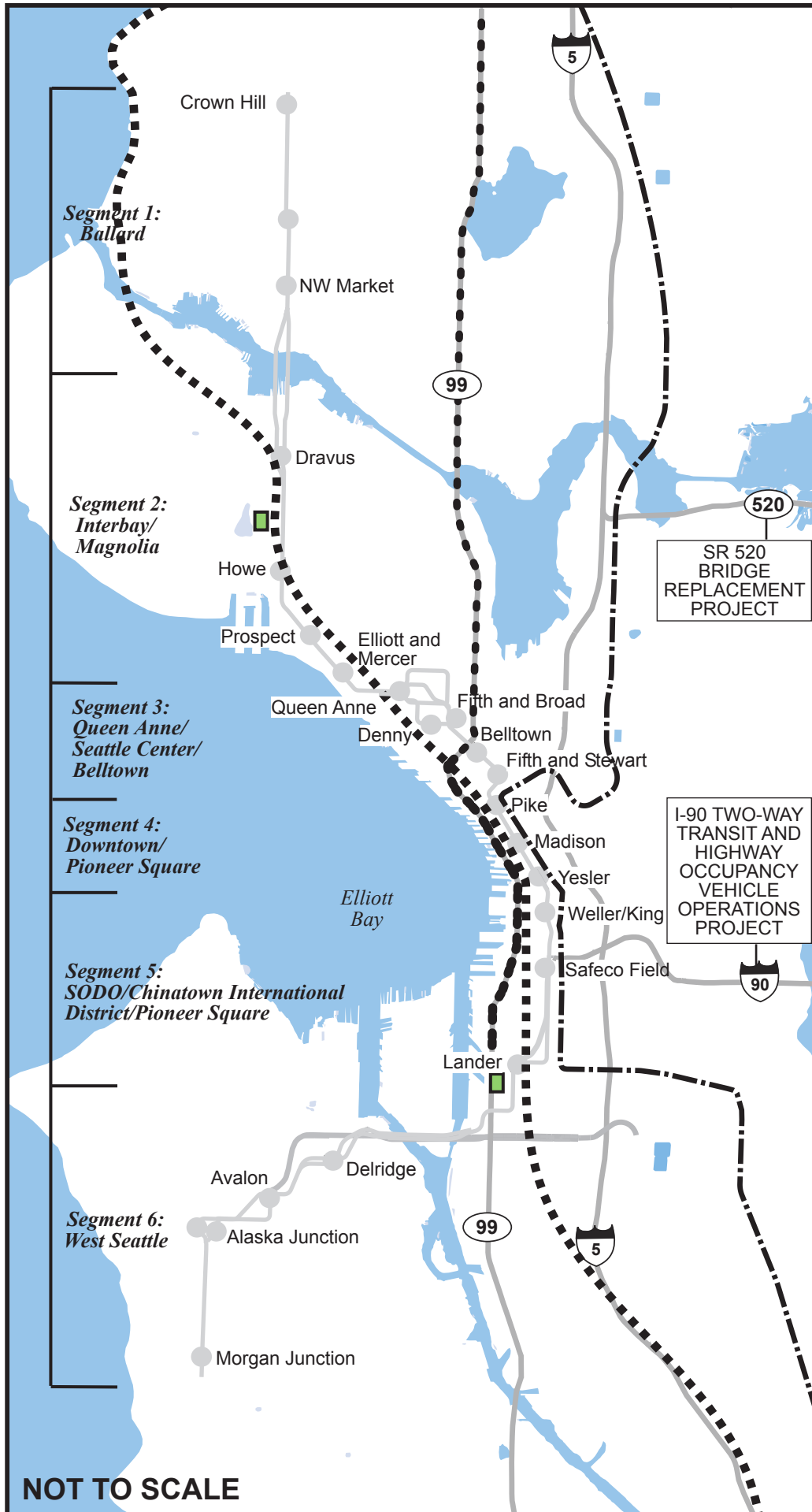
- 4.1 - West Side of Second
- 4.2 - East Side of Second with Crossover
- 4.3 - Center of Second

Segment 5: SODO

- 5.1 - East side of Third/Utah
- 5.2 - West side of Third/Utah

Segment 6: West Seattle

- 6.1 - West Seattle Bridge
- 6.2 - New Bridge



- City of Seattle: Leary Way NW & NW 46th Street Multi-modal Transportation Improvements
- City of Seattle: Magnolia Bridge Replacement
- Port of Seattle: Fishermen's Terminal Dock Reconstruction
- Port of Seattle: North Bay Master Plan
- Seattle City Light: Interbay Substation
- City of Seattle: South Lake Union Improvements
- Seattle Public Schools: Memorial Stadium Improvements
- King County: Convention Place Station Transit-Oriented Development
- WSDOT and Sound Transit: King Street Renovation and Weller Street Bridge
- City of Seattle: Spokane Street Viaduct Widening
- City of Seattle: S Lander Street Grade Separation
- King County: Combined Sewer Overflow Improvements
- WSDOT and City of Seattle: SR 519
- Amtrak: Maintenance Facility Upgrade
- King County Metro Transit: Expansion of Atlantic, Central, and Ryerson Bases
- King County Metro Transit: Power Distribution Headquarters Replacement
- Port of Seattle: E Marginal Way Grade Separation
- Port of Seattle: Terminal 46 and Pier 48
- BNSF, Amtrak and Sound Transit: Rail Improvements
- Seattle Housing Authority: High Point Revitalization Project
- Aurora Avenue North (SR 99) Multimodal Corridor (Bus Rapid Transit) Project
- Seattle City Light Interbay Substation
- King County Combined Sewer Overflow Project
- Amtrak Maintenance Facility

4.16.2 Operational Cumulative Impacts

4.16.2.1 Cumulative Transportation Impacts

The future analysis of traffic and transit impacts in Section 4.1, Transportation, is a cumulative analysis based on the results of traffic and ridership modeling that incorporates past actions and approved future actions (SR 520 Bridge Replacement Project, Sound Transit Light Rail and Commuter Rail Projects, Sound Transit I-90 Two-Way Transit Project), as well as projected growth that would result from development in the region. The WSDOT/City of Seattle Alaskan Way Viaduct project and the King County Metro Transit, City of Shoreline, and City of Seattle Aurora Avenue North Multimodal project, two major unfunded projects, are also considered in this cumulative impacts section. In general, any Green Line alternative could result in less VMT regionally and higher levels of transit service than the No

Action Alternative. Any decrease in motor vehicle trips and VMT from the Green Line could be partially or fully offset by latent demand for traveling in the Green Line corridor.

Sound Transit's light rail and commuter rail systems and the City of Seattle's South Lake Union Streetcar, if developed as proposed, could increase ridership on the Green Line by acting as feeders. There is also some potential for adverse cumulative impacts, such as increased traffic congestion, increased parking demand, decreased parking supply, and increased pedestrian activity at transfer station locations. These impacts could be notable at the Weller/King Street station, where transfers between buses, light rail, and the Green Line could occur. SMP will coordinate with Sound Transit, the City of Seattle, King County Metro, and other transportation providers to avoid and/or mitigate these impacts. Other locations where light rail, streetcar, and Green Line stations are in close proximity are the SODO stadium area and the Westlake Mall area in Downtown. Refer to Section 4.17.17 for a discussion of cumulative construction impacts.

Retrofitting and replacing the Alaskan Way Viaduct (AWV) and waterfront seawall could present an opportunity to improve pedestrian and vehicle access into and out of Downtown Seattle, improve freight mobility in south Seattle and beyond, and reconnect the street grid system over Aurora Avenue in the Seattle Center area. Few long-term, cumulative impacts are expected, although improvements resulting from the Alaskan Way Viaduct project could increase non-motorized and transit demand in Downtown, potentially increasing Green Line ridership and pedestrian activity in Downtown. In addition, both projects would potentially have an adverse cumulative impact on parking in Downtown Seattle. Refer to Section 4.17.17 for a discussion of cumulative construction impacts. During construction of AWV, some of the AWV traffic could be rerouted to Downtown surface streets, including Second Avenue for southbound traffic. To the extent Green Line alternatives would increase traffic delay along that street, this could be a significant cumulative impact, depending on the volume of traffic rerouted by AWV. The operation of the Green Line would also provide additional capacity along this corridor.

City of Seattle transportation projects such as Elliott/15th Avenue W Multi-modal Transportation Improvements, Leary Way NW & NW 46th Street Multi-modal Transportation Improvements, Magnolia Bridge Replacement, South Lake Union Improvements, Spokane Street Viaduct Widening, S Lander Street Grade Separation, SR 519, and E Marginal Way Grade Separation could improve freight mobility and vehicle access throughout Downtown, Interbay, and SODO. However, projects that increase roadway capacity would also have the potential to increase vehicle volumes.

Major private development projects and major public development projects identified in Section 4.16.1, such as Amgen's Helix Centre and King County Convention Place Transit-Oriented-Development project, could potentially result in localized travel demand increases; however, traffic and ridership projections for the Green Line are already based on growth projections that incorporate increased development, and these specific projects would not greatly change overall transportation conditions. The private development projects identified in the Seattle Center/Queen Anne/Belltown, Downtown/Pioneer Square, and West Seattle Segments could create a substantial number of residential and office units and could result in impacts from higher ridership.

The Green Line and Sound Transit Link projects would both provide bicycle parking and other facilities in and around stations. The projects would result in cumulative benefits for bicyclists, particularly in the SODO area where both projects have stations near the stadiums and Lander Street.

4.16.2.2 Cumulative Displacement Impacts

Projects such as the Green Line, Alaskan Way Viaduct, SR 519, and Sound Transit Central Link could require acquisition of private and public property in Seattle. These properties consist of developed

properties that are used for commercial/industrial, public, or residential purposes, as well as undeveloped property. Several surface parking lots, considered developed commercial properties, could be acquired. All public projects would mitigate displacement impacts by purchasing property at fair market value and by providing relocation assistance to owners and qualified tenants. Private parties do not have the power to condemn property and are unlikely to be required to provide relocation assistance for tenants who are required to move as a result of redevelopment.

4.16.2.3 Cumulative Land Use and Neighborhood Impacts

The Green Line and other transit projects, such as Sound Transit's Light Rail and Commuter Rail projects, could allow the region to better achieve its regional growth management strategy. The projects would not directly prevent sprawl (low-density, dispersed patterns of growth), but would provide mobility and access options that could encourage higher densities and reduce land consumption, consistent with regional and local plans and policies.

Cumulative land use and neighborhood impacts are not expected to be substantial. Cumulative or induced growth impacts are unlikely in the Ballard, Interbay, and West Seattle Segments of the Green Line because of the relatively small number of projects planned for those segments, or in the Seattle Center/Queen Anne/Belltown and Downtown/Pioneer Square Segments because of the already high concentration of retail, residential, office, and entertainment uses in those neighborhoods. A possible exception is the neighborhood around the Pike Street station alternatives where there is some redevelopment potential. The transportation projects planned for the SODO Segment are consistent with and would benefit existing land uses. The Seattle Center could experience noise, visual, and displacement impacts; however, the cumulative impact on the land use would not be significant.

4.16.2.4 Cumulative Economic Impacts

The population and employment impacts discussed in Section 4.4, Economics, are cumulative, as they are based on PSRC forecasts that take into account past and future actions affecting population, employment, land use, and changes in the transportation system. Construction of the major projects currently planned for the Seattle area, including the transportation projects listed below, could reduce unemployment and increase area income. Given the currently high vacancy rates for commercial, industrial, and residential property, it should be easier to find replacement property for businesses and residents, and cause less disruption to property owners and tenants. Based on available information, these high vacancy rates are likely to continue in the future, through the Green Line's construction. High vacancy rates also ensure that there should be no shortage of replacement properties if construction of all of the projects coincides.

The Green Line has been planned to accommodate projected growth in Seattle. Other major transportation projects, however, would involve increased access to the region's core urban areas. Major transportation projects such as Sound Transit Light Rail and Commuter Rail lines; WSDOT/City of Seattle Alaskan Way Viaduct project; SR 520 Bridge Replacement project; Sound Transit I-90 Two-Way Transit and HOV Operation project; and King County Metro Transit, City of Shoreline, and City of Seattle Aurora Avenue North Multimodal project could support increased access primarily to Downtown Seattle. The improved access that could occur in areas coinciding with the Green Line could increase station-area activity and accelerate development and redevelopment activities in the areas mentioned above, with more intensive land uses replacing lower-density uses. This would remain consistent with the general goals for growth both at a regional level and within the city, but it may occur sooner than might otherwise be anticipated.

4.16.2.5 Cumulative Visual and Aesthetic Impacts

In general, other reasonably foreseeable transportation and land use development projects near the Green Line would be consistent with Seattle's policies to concentrate and intensify urban development. In parts of Ballard and West Seattle, where existing uses are vehicle-oriented and/or less dense than allowed by City plans and zoning, the visual change of reasonably foreseeable redevelopment could include larger buildings, greater visual scale, and higher pedestrian orientation than the existing or No Action conditions. In such locations, the Green Line could be more visually compatible with these developments than with existing conditions. The Green Line, S Lander Street Grade Separation project, E Marginal Way Grade Separation Project, and SR 519 Project would introduce large above-grade structures in the SODO area. This cumulative visual impact is not expected to be substantial due to the industrial nature of the area.

4.16.2.6 Cumulative Air Quality Impacts

Both the regional VMT and the traffic data used in the air quality hot spots analysis were based on travel demand forecasting models that incorporate the effects of past and future actions affecting population, employment, land use, and changes to the transportation system. Regional VMT estimates are based on regional modeling, which incorporates projected changes to land use, employment, population, and travel behavior. On a regional basis, the Green Line could reduce VMT and could contribute positively to (reduce) cumulative regional transportation-related air pollutant emissions.

Cumulative construction-related impacts could be caused by multiple construction projects in the project area causing larger accumulations of construction-related emissions from diesel-fired equipment and fugitive dust sources. Because construction of the Green Line is expected to proceed block-by-block, disruptions to traffic flow and associated congestion would be short-term and localized. Therefore, no significant cumulative air quality impacts are expected.

4.16.2.7 Cumulative Noise and Vibration Impacts

The traffic noise impact analysis in Section 4.7 is based on projected future traffic volumes for the project, as well as forecasted background traffic growth and programmed transportation improvements. All Green Line alternatives are expected to result in similar impacts. FTA noise criteria address cumulative impacts by using a sliding scale that allows less project-related noise increase where ambient noise levels are already high. Most transportation projects currently in the planning stage are not expected to result in substantial noise or vibration level increases adjacent to the Green Line alignment. The Alaskan Way Viaduct project could have some noise impacts if the at-grade, elevated, or retrofit alternative is constructed; the Alaskan Way Viaduct project could also reduce noise pollution below existing levels. Other projects that could result in localized noise or vibration increases include the Sound Transit light rail and commuter rail lines; I-90 HOV project; King County Metro Transit, City of Shoreline, and City of Seattle Aurora Avenue North Multimodal project; and several of the larger commercial developments.

4.16.2.8 Cumulative Energy Impacts

Although operation of the Green Line would increase the demand for electrical energy, it is expected to decrease the energy demand for other transportation modes in the city of Seattle (mainly in the form of petroleum and diesel). Transit projects such as the Green Line and Sound Transit's Light Rail and Commuter Rail projects have the potential to cumulatively decrease energy use. Vehicle-oriented transportation projects and other development projects would cumulatively increase energy use and are more likely to be implemented as the region's population and employment grow.

4.16.2.9 Cumulative Impacts on Public Services and Utilities

Proposed transportation and private development projects and general growth along the Green Line could increase the need for fire and emergency medical, law enforcement, and other public services. The Green Line, together with numerous proposed developments and major roadway changes, would alter roadway infrastructure and may affect future traffic patterns. In turn, these changes may affect existing public service access and vehicle routes.

Cumulative impacts on emergency vehicle response times resulting from the Green Line in combination with other planned projects could be higher than with the Green Line alone. Transit-dependent users of public and social services at various locations along the Green Line and Sound Transit Light Rail line would benefit from the additional access provided by the transit systems.

Continued growth in the project area could increase demand on existing utilities, ultimately requiring service providers to increase their capacity and infrastructure. While not requiring substantial new utility resources, the Green Line could add to this increased demand. Generally, electrical, water, sewer, telecommunications, and other utilities currently have sufficient capacity or are adding additional capacity to serve the region in the future (based on local capital facilities plans). Taking into account the total growth projected in the region, the Green Line is not anticipated to change the forecasts of area service providers. Projects such as the Green Line, Alaskan Way Viaduct, Sound Transit Light Rail, Aurora Avenue North Multimodal project, Elliott/15th Avenue W Multi-modal Transportation Improvement, Leary Way NW & NW 46th Street Multi-modal Transportation Improvement, Magnolia Bridge Replacement, South Lake Union Improvements (including Mercer Corridor Improvement project and South Lake Union Streetcar), Spokane Street Viaduct Widening, S Lander Street Grade Separation, SR 519, and E Marginal Way Grade Separation projects could require utility providers to relocate their facilities. The Seattle City Light Interbay Substation and King County Combined Sewer Overflow projects involve upgrades to major utilities near the Green Line. SMP would coordinate utility relocation with other project proponents; however, utility providers may be required to relocate their facilities at different times for different projects over the years.

4.16.2.10 Cumulative Park and Recreation Impacts

Transit projects such as the Green Line and Sound Transit's light rail would improve access to parks and recreational facilities near Green Line stations such as the Ballard Swimming Pool and other recreational facilities, Westlake Park, Tilikum Park, and Occidental Square. No adverse cumulative impacts are expected for parks and recreation.

4.16.2.11 Cumulative Impacts on Cultural Resources

Potential impacts to archaeological sites resulting from construction of the Green Line would combine with impacts of planned projects in areas within the City of Seattle that have a high probability for hunter-fisher-gatherer, ethnographic period, or historic period archaeological resources.

Areas with a high probability for archaeological resources in Seattle include:

- Marine shorelines such as the former margins of Salmon Bay and Smith Cove in Ballard and Interbay and the early historic period shoreline and tideflats of Elliott Bay in Interbay, Downtown Seattle, SODO, and West Seattle.
- The Duwamish River floodplain and the former tideflats at the mouth of the river.
- Streams with salmon runs.

The City of Seattle Magnolia Bridge Replacement project and the Port of Seattle Fishermen's Terminal Dock Reconstruction project may include construction excavation or other subsurface ground disturbance in areas with a high probability for archaeological resources in the Interbay vicinity. Construction excavation for the City of Seattle South Lake Union Improvements project may affect archaeological resources on and adjacent to the early historic period shoreline of Lake Union, which could extend to areas near the Fifth Avenue monorail route in Belltown.

Projects that may affect archaeological resources on the Downtown Seattle waterfront and SODO area include the Alaskan Way Viaduct project; WSDOT/City of Seattle SR 519 project; WSDOT King Street Renovation project; King County/Sound Transit Weller Street Bridge project; City of Seattle S Lander Street Grade Separation project; Port of Seattle E Marginal Way Grade Separation project; City of Seattle Spokane Street Widening project; King County Metro Transit Atlantic, Central, and Ryerson Base Expansion; King County Metro Transit Power Distribution Headquarters Replacement; and Amtrak Maintenance Facility Upgrade.

Potential impacts to historical resources resulting from construction of the Green Line combined with impacts of planned projects in the area could have a significant effect on some of the historical resources identified within the Green Line project's area of potential effect. For areas such as the Downtown Segment, with a high number of historical resources, there may be a greater effect from noise, visual, or demolition impacts. Cumulative impacts to historical resources within the Ballard and West Seattle segments are unlikely due to the limited number of historical resources and the types and location of potential projects. In Interbay, the City of Seattle Magnolia Bridge Replacement Project may affect historical resources identified within this segment. The Seattle Public Schools Memorial Stadium Improvements project could cause effects to historical resources that have been identified within Seattle Center.

Additional private development projects could also affect historical resources. Projects that may affect historical resources within the Downtown and SODO segments include the Alaskan Way Viaduct and Seawall Project, WSDOT/City of Seattle King Street Renovation and Weller Street Bridge Project, WSDOT and City of Seattle SR 519 Project, and possibly some private developer projects.

Impacts to historical resources within historic districts have an adverse cumulative effect on the integrity of the district. The construction and operation of the Green Line would have a significant adverse visual impact on individual resources and those located within historic districts. The introduction of new construction would alter view corridors and the ability to see and experience individual buildings. Streetscapes or rights-of-ways would be altered or eliminated (see Appendix N, Section 106 Cultural Resources Report, and Section 4.5, Visual Quality and Aesthetic Resources).

4.16.2.12 Cumulative Environmental Health Impacts

Projects that require acquisition of land, such as the Sound Transit Light Rail project, Alaskan Way Viaduct project, and private development projects, have the potential to clean up contaminated sites that would otherwise remain contaminated.

4.16.2.13 Cumulative Earth Impacts

No cumulative impacts to geological resources are expected.

4.16.2.14 Cumulative Impacts to Water Quality

The Green Line and other planned transit projects would provide mobility and access options that would encourage the region and local jurisdictions to achieve higher densities and to reduce land consumption consistent with regional and local plans and policies. Providing alternatives to the use of cars could lessen the need for parking facilities and could reduce pollutant loading in runoff from roadways and parking lots, as discussed in Section 4.14, Water. In this context, both the direct and indirect cumulative impacts on water quality would be expected to be lower with the Green Line than with No Action.

Most projects listed in Section 4.16.1 would occur on sites that are already developed. As such, the cumulative impacts from these developments on water quality are expected to be minimal as long as appropriate best management practices (BMPs) are employed to mitigate operational impacts of increased stormwater runoff and pollutant loadings.

4.16.2.15 Cumulative Impacts to Plants and Animals

No project is expected to occur along the Green Line route in the foreseeable future that would measurably add to any unmitigated effects of the project. SMP has been coordinating with the Muckleshoot Tribe and no cumulative impacts to tribal fisheries have been identified. Implementation of the Green Line would reduce the demand for transportation services that might require new or expanded facilities along the same corridor. No cumulative impacts on plants and animals (fish or wildlife) are expected from the project.

4.16.2.16 Cumulative Impacts to Construction

Section 4.17.17 contains a description of the potential major capital and transportation projects that could undergo construction at the same time as the Green Line and describes the measures SMP would take to coordinate construction activities and mitigate impacts.

4.16.3 Cumulative Impacts of the No Action Alternative

The No Action Alternative represents the transportation system and the environment as it would exist without the Green Line, and includes the transportation and development projects listed in Appendix II. With the No Action Alternative, a transit element of the regional growth strategy (the Green Line) would not be completed. The No Action scenario could make it harder for the region to achieve its growth management strategy by losing an opportunity to provide an alternative to driving. This could lead to development in locations not identified by the regional growth strategy and impacts on mobility, air quality, water quality, and energy consumption. The Ballard, Interbay, Queen Anne, Seattle Center, Belltown, and West Seattle neighborhoods would not be served by grade-separated transit if the No Action alternative is selected. Connections to regional transit systems, such as light rail and commuter rail, would not be improved.

4.16.4 Mitigation for Cumulative Impacts

The mitigation measures discussed in Sections 4.1 through 4.15 and 4.17 and in Chapter 5 apply to the cumulative impacts identified above. SMP will work with the proponents of other projects to minimize adverse cumulative impacts. In particular, coordination of construction activities among Sound Transit, WSDOT, City of Seattle, and SMP on the Green Line, Link Light Rail, Alaskan Way Viaduct and Sea Wall Reconstruction, Mercer Corridor Improvements, and South Lake Union Streetcar projects will be critical. The coordination between these agencies and King County Metro Transit and Community Transit could be implemented through the Monitor and Maintain Committee that was established to

review various measures for light rail construction mitigation and to determine which improvements benefit downtown transit and general-purpose traffic operation. With mitigation and coordination, no significant adverse impacts would be expected to occur other than those previously mentioned in Sections 4.1 through 4.17.

4.17 CONSTRUCTION

The Green Line project would construct approximately 14 miles of elevated guideways, up to 19 stations, 10 to 20 traction power substations, and an Operations Center. It would be a major public works construction project. Green Line construction is anticipated to begin in 2005 and continue into 2009, with system testing and integration efforts occurring up to the start of full line operation in 2009. SMP intends to begin operation of an initial Green Line segment on December 15, 2007, while construction continues on the remainder of the line. The portions of the initial line to be completed first would depend on a number of factors, including the location of the Operations Center.

The impacts of construction are discussed in this section, covering the areas of the environment discussed in Sections 4.1 through 4.16. Previous sections have discussed the affected environment for the project for both construction and operation; this section focuses specifically on construction impacts and mitigation. The sections on the specific environmental discipline areas contain more detailed information on the methodology and description of the affected environment. Some sections, such as Displacements and Environmental Health, contain more specific discussions of construction impacts, which are summarized here.

The Green Line will be constructed through a Design-Build-Operate-Maintain (DBOM) approach, through which a contractor team will be selected to design and implement an integrated approach to the Green Line's development. DBOM and other similar construction approaches have been used for major public works projects around the country because of their ability to provide a coordinated approach to a complex project. Some of the specific details related to construction will be determined after the DBOM contract is awarded and the successful contractor team develops a detailed design and construction plan prior to issuance of construction permits. However, construction would occur within the parameters outlined and evaluated in this EIS and all construction activities would conform to environmental conditions of resource and permitting agencies and regulatory guidelines.

In mid-2003, SMP completed a selection process for the DBOM approach that resulted in two teams, Cascadia Monorail Company and Team Monorail, being identified as qualified to submit specific proposals. The procurement process continued with the release of a Draft Request for Proposals issued for industry and public review in December 2003, and a Final Request for Proposals in February 2004. Because the two competing teams use different monorail technologies with different cars, guideway beams, switches, and other components, the selection process will be completed before final design work is done on the Green Line's alignment and station locations. The selected DBOM contractor will be responsible for finalizing details of design, coordinating and implementing all construction tasks, and implementing specific mitigation measures outlined in Chapter 5, Mitigation Program.

4.17.1 Description of Green Line Construction

The environmental impact analysis of construction activities is based on SMP's expectations for construction operations, including the possible activities and durations that are assumed to be used by the construction contractors. Differing construction techniques and technology are available for many of these construction activities that may mitigate or reduce environmental impacts. Durations for construction activities are estimates and could vary depending upon permit conditions and contractor approaches.

Anticipated construction activities are described for the following:

- Guideways and columns (Section 4.17.1.2).

- Special structures for guideways (Section 4.17.1.3)
- Stations (Section 4.17.1.4)
- Bridges (Section 4.17.1.5)
- Construction staging areas (Section 4.17.1.6)

4.17.1.1 Typical Construction Durations, Activities, and Equipment

Construction activities in any of the six geographic segments could be intermittent and not necessarily continuous over an approximately 24-month period, although complex tasks could involve up to 48 months of intermittent construction in some locations. Construction activities would be coordinated and phased to minimize the extent of any potential impacts to the surrounding communities. In addition, construction activities would be subject to construction permitting requirements.

Some construction activities may occur on a 24-hour basis and on holidays and weekends as negotiated with the City of Seattle, although others could be conducted during a typical or extended workday period, depending in part on where the construction activity is located. Where 24-hour construction or construction on holidays or weekends would occur, additional conditions or permitting requirements could apply. The intensity and type of activities that occur could be adjusted to avoid or minimize significant impacts. A work-specific construction plan would be developed prior to the final design and contractor selection phases of the project. The construction plan would establish the limits for construction, including its estimated schedule and duration, construction approaches, and appropriate sequencing. Where possible, construction activities would be coordinated with other capital improvement projects to help minimize construction impacts.

Green Line construction would require the use of heavy equipment, as noted below in Section 4.17.1.2, Guideway Construction. The construction work at stations, along the guideways, and at the Operations Center would typically begin with site preparation, including demolition and clearing, and utility relocation. In some areas, it could be necessary to demolish existing sidewalks, buildings, or structures before beginning Green Line construction. This initial phase of construction could also involve the following: implementing stormwater and erosion control measures; relocating utilities; removing debris; containing and disposing of hazardous materials; localized sidewalk, street, or lane closures; creation of noise and dust; and truck traffic to remove debris or deliver materials. Construction sites could also require temporary lighting, power supply or power generators, as well as pumps or other motorized equipment. After the initial construction phase, construction activities are expected to vary according to the facility, as discussed below.

4.17.1.2 Guideways and Columns

Guideway construction would consist of foundations, column and crosshead (guideway beam support structure) installation, with sequential guideway beam installation for areas between stations. The work would include foundations, columns, and guideway beams. In some cases, foundations may require ground improvement or utility relocations as described below. For the purposes of describing the work in typical city blocks of approximately 300 feet long, possible construction stages, work concepts, and durations are discussed below. Each (typical block) section would have construction activity for a period of time that could range from three to five months, depending on site conditions and the types of construction methods selected. Activities for a typical block section may occur in the following approximate duration (Table 4.17-1) (see Appendix X of the Draft EIS, Construction Backup Information, for diagrams of each construction stage. This information has not changed for this Final EIS).

Depending on the final location of the guideway alignment, the size of foundations, and type of equipment required, sidewalk closures and temporary lane or full street closures may be required. Transit facilities, including bus stops and trolley bus lines could also be affected. The duration of the street closures and the number of lanes closed will vary by the guideway route and the location of the guideway. For purposes of this EIS, it is assumed that guideway construction in or near the existing outside lanes of any streets would close that lane and potentially one adjacent lane for the duration of the construction. Additionally, for equipment movement, utility relocation, and moving and placing precast guideway elements onto the work site and into place, additional lanes may be needed on a short-term basis. Most of these multi-lane closures would likely occur during off-peak hours of the day or weekends that are not traffic intensive.

4.17-1. Typical Construction Duration for a 300-foot Guideway Section

Stage	Activity	Duration (weeks)
Stage 1 ^a	Clear foundation areas, relocate utilities	1-6
Stage 2, 3, and 4	Construct foundations	2-4
Stage 5	Install columns	2-4
Stage 6	Install beams	1-2
Stage 7	Install cable trays and walkways	1-2
Stage 8	Repair, restore roadway and streetscape as needed	2-4

^a Time for this stage could be longer where utility relocations are more concentrated or difficult (e.g., undergrounding of electrical power). Utility relocations also will frequently take place in longer than 300-foot sections. Time could also be longer if hazardous materials must be removed or if ground improvements must be made.

Guideway construction in the center of streets would typically require closure of each lane adjacent to the construction and could require a total of two or three lanes to be closed, depending on the street layout. Similarly, moving equipment, relocating utilities, and moving elements and placing them on the guideway may require additional lanes to be closed temporarily. Techniques will be developed to reduce the traffic lane closures and would be part of the development of detailed transportation management plans for each section of construction.

In general, the roadways directly along the Green Line route could have lane closures and restrictions that could affect traffic and transit operations for several blocks at any one time. Periodic closures or restrictions along roadways with longer sections of the alignment could last for up to two years. Depending on the alternative, the affected roadways could include:

Ballard

- 15th Avenue NW

Interbay/Magnolia

- 16th Avenue W
- 15th Avenue W
- W Armory Way
- Elliott Avenue W

Queen Anne/Seattle Center/Belltown

- W Harrison Street
- Denny Way
- Mercer Street
- Fifth Avenue N/Fifth Avenue

Downtown/Pioneer Square

- Stewart Street
- Second Avenue

SODO/Chinatown ID/Pioneer Square

- Third Avenue S
- S. Utah Street
- S. Horton Street

West Seattle

- West Seattle Bridge
- SW Spokane Street
- Delridge Way SW
- SW Yancy Street

West Seattle (continued)

- SW Genesee Street
- SW Avalon Way
- SW Andover Street
- Fauntleroy Way SW
- 35th Avenue SW
- SW Alaska Street
- 42nd Avenue SW
- 44th Avenue SW
- California Avenue SW

Shorter segments and roadways that the alignment would cross may have shorter-duration restrictions of six months or less, and closures could be intermittent for up to two years. Techniques will be developed to reduce the traffic lane closures and would be part of the development of detailed traffic management plans for each component of construction.

Individual transportation facilities that may experience full or partial temporary closures are discussed in the transportation impact analysis for construction in Section 4.17.2.

Typical Equipment Involved in Guideway Construction

The construction of the Green Line guideway would involve many different types of equipment, including excavators, loaders and graders, backhoes, and dump trucks, which could be sources of noise, vibration, dust and dirt, and exhaust. Falsework, including scaffolding, formwork, or other temporary structures may be used throughout the construction period. Haul trucks and delivery trucks near construction staging sites could be used throughout the length of the construction period. Haul truck and delivery truck volumes would vary depending on ongoing activities at the time. Truck traffic is anticipated to occur primarily on arterials between staging areas and nearby highways (e.g., I-5, SR 99, and I-90).

For guideway sections, truck and crane mounted auger drills for drilled shafts, and various sizes of cranes could be used. Pile drivers could be used in some areas of the alignment where soil conditions make drilling less desirable. The method of construction to be used along each area of the guideway would be determined based on environmental and community considerations including soil conditions, location of underground utilities, and adjacent building types. Smaller equipment, including jackhammers, pavement saws, hoerams, generators, pneumatic equipment, welders, and others would be a standard part of the construction. Diagrams showing the typical construction sequence are shown in Appendix X of the Draft EIS, Construction Backup Information. This information has not changed for this Final EIS. The following includes a more detailed narrative of the construction activities and techniques for the potential stages of guideway construction.

Stage 1 – Move Utilities and Clear Foundation Sites

Underground and overhead utilities would typically be relocated in advance of the construction of the guideway (see Volume 5, Appendix X of the Draft EIS, Figures 1 and 2 for a possible layout of utility relocation and foundation clearing activities for a typical guideway location). Existing piping, conduits, and buried utilities that encroach on the areas required for guideway foundations would be removed and relocated to another location, ideally in the existing right-of-way. Trenches would be excavated to provide for the new utilities with pavement saws, backhoes, front-end loaders, and dump trucks. The existing pavement would be cut and removed, and soils would be excavated to a sufficient depth to place the new utilities. The clearing of foundation sites and the relocation of utilities could also require the removal or trimming of existing street trees and landscaping features. Potential tree removal and trimming is discussed in more detail in Section 4.17.6, Visual Quality and Aesthetic Resources, as well as in Appendix W of the Draft EIS, Tree Survey Backup Information.

Removal of the existing Seattle Center monorail's columns and guideway beams would be accomplished during this stage. Columns would be removed to the pedestal of the pile cap, approximately three feet below ground so that the street surface can be restored.

Rather than relocate underground utilities that are adjacent to foundations, with the approval of the utility company, pipe or duct banks could be protected, reinforced, or upgraded rather than relocated. If deep trenches are required, they would be supported through the use of temporary shoring to assure worker safety and to prevent damage to adjacent utilities. In some cases, it may be necessary to remove concrete pavement in structural slab sections to relocate underground utilities. Existing underground utility service connections to the adjacent residences or buildings on either side of the street would be extended or shortened by trenching and extending or truncating utility service to the relocated utility mains. In some cases, it could be necessary to repair existing utilities and service lines that are crossed by the new utility mains, such as at street intersections or in areas where utilities are congested.

Overhead utilities and infrastructure such as power, trolley wires, and traffic lights may be temporarily relocated during guideway construction. Utilities that encroach on the utility clearance requirements would be relocated underground or to an overhead location elsewhere in the right-of-way. Depending on the location, the temporary relocation of trolley wires could also involve transit system service disruption issues, and is discussed in more detail in Section 4.17.2 under transportation impacts during construction.

Stages 2, 3, and 4 – Column Foundations

The foundations for the columns that support the guideways would typically be drilled shafts into competent subsurface soils that are filled with reinforced concrete to form a stable column foundation. A variety of construction methods can be used to perform this work. (The activities for one of the possible methods are described below, and are depicted in Volume 5, Appendix X of the Draft EIS).

Constructing column foundations would require the removal of portions of the existing street paving, sidewalks, or curbs at locations where surface improvements exist. In Downtown Seattle, the street is paved with sections of reinforced concrete paving slabs that are up to 12 inches thick, one traffic lane wide, and about 16 feet long. A portion or all of one or more paving slabs could be removed at every foundation.

Drilled shaft foundations can support substantial distances of the guideway. Shafts would generally be sized from six to 12 feet in diameter. Shaft depths may vary in depth from 30 to greater than 100 feet, depending on the soil conditions, seismic requirements, and structure design. One method of shaft construction would use an oscillating temporary steel casing rotated deep into the soil, in advance of an auger-type drill used to excavate the soil from inside the casing. Typically, the auger equipment is capable of excavating soil directly from the cased shaft into dump trucks. However, some types of equipment require that the auger spoils (the soil removed during drilling) be dumped on the surface, and loaded by front-end loader into dump trucks. Once the shaft excavation is completed, and inspected, a steel reinforcing cage and testing tubes would be inserted in the resulting hole, which would then be filled with concrete (access space for concrete trucks and a concrete pumping truck would be required). A temporary steel casing may be used and would be withdrawn at this point as the hole is filled with concrete. Drilling and pouring a shaft typically requires approximately two days but can require up to two weeks depending on depth and complexity. The shaft concrete must cure before subsequent work is done above, with curing periods from four to seven days or longer.

A possible construction method would use a shaft cap to accommodate connections for precast concrete columns. The drilled shafts could require concrete caps, of varying sizes that would likely be placed about two feet below the final grade, but in some circumstances could be at or above grade for design reasons. Each cap would be slightly larger in diameter than the drilled shaft below, and would be formed, reinforced with steel and column connection hardware, and cast with concrete. A temporary steel form might allow the cap to be constructed in less than one week. The concrete cap would most likely be cast-in-place and would cure for four to seven days or longer before installation of a precast column. Conduit for electrical distribution or communication cables may be installed through the shaft caps to connect to conduits in the center of the columns. Traffic barriers and steel plates would be used to secure excavated holes for shafts and caps. Other construction methods may involve post-tensioned precast segmental columns or reinforced concrete cast-in-place columns that may not use a shaft cap and may use different methods for connecting the columns to the drilled shaft foundations.

In the area of soft soils east of the West Seattle Bridge high-rise structure, between Harbor Island and the Alaskan Way Viaduct, foundation pile caps would likely be supported by steel pipe piles driven to depths of 100 to 150 feet or more below grade. Similar techniques could be considered in areas where contaminants are determined to be present and where soil excavation is not desirable. Pile driving would be a source of noise and vibration, but has been successfully used for foundations on other major projects such as Safeco Field and the Seahawks Stadium. The pile caps would be constructed of reinforced concrete. Each foundation might take between two to four weeks or more to drive the piles and form and cast the pile cap. The pile cap concrete would cure for four to seven days or more before installation of a precast or cast-in-place column. Construction methods for each area would be determined consistent with noise and vibration standards and impacts to historic resources.

Stage 5 – Column Installation

A variety of methods can be used for construction of the columns including precast concrete single unit columns, precast concrete segmental columns, or cast-in-place reinforced concrete columns. In some cases, the columns may be steel. Columns for both horizontally and vertically aligned guideway beams could be constructed using these materials.

The most likely method of constructing columns would use the cast-in-place concrete method. These columns would use reinforcing steel cages tied above reinforcement extending from the shaft caps or pile caps. Temporary wood or steel forms would be fitted around the reinforcing cage and secured. Concrete would be poured in multiple lifts, depending on the strength of the formwork. Each lift would need to reach a given strength before the next lift could be poured. The top lift of concrete in the column would cure for four to seven days or more before subsequent crosshead forming and pouring work is done above.

Cast-in-place concrete crossheads would be used above cast-in-place concrete columns. These would require forms that could be supported by column forms, hung from the concrete column top when cured, or extended from the ground surface. Forms must stay in place until the completion of the curing period, and then forms and shoring would be removed.

Another representative construction method using precast concrete single unit columns and representative of potential construction impacts is described below. (Volume 5, Appendix X of the Draft EIS, depicts possible staging area activities and layout for column installation.)

Precast, reinforced concrete columns would be integrated with either steel or precast, reinforced concrete crossheads in an off-site casting yard. These column/crosshead units would be shipped to the work site

on long flatbed trucks or specially equipped tractor trucks. Before the columns are installed, temporary stairs and scaffolding would be placed adjacent to each column location, to aid workers in aligning the column tops and in connecting beams to the crossheads. The column/crosshead units would be installed using a large mobile crane. The columns would be aligned and raised or lowered to the correct position using special attachments at the tops of the foundation shaft caps, and would then be grouted to complete the permanent connection with the foundations. Placing temporary stairs and scaffolding, and installing and grouting one column could require up to one week. The grouted connection would need to cure before beams are installed.

The crosshead designs would include a mechanism for attaching and aligning the guideway beams. For steel crossheads, a steel upright would be welded to the body of the crosshead to support plates extended from the beam ends. Each beam would have a guide plate allowing adjustment for tilt, which would be welded to the crosshead steel upright. For precast concrete crossheads, either a steel upright or bolts could be used to secure the beams to the crosshead.

Vertically arranged (Iris) columns may be constructed using either steel, precast concrete, or cast-in-place concrete. Concrete columns would have larger proportions than steel column designs. Steel columns would require painting. Foundations would be drilled shafts or driven piles as with typical column configurations.

Stage 6 – Guideway Beam Installation

Guideway beams could be constructed of steel or precast concrete. A description of one possible method of guideway beam installation representative of potential construction impacts is illustrated in Volume 5, Appendix X of the Draft EIS.

Typical precast concrete guideway beams would be prestressed in an off-site casting plant and transported to the work site on special tractor trucks. The beams may range in length from about 60 to 150 feet or longer and may be of uniform cross-section through their length or be “haunched” (with the thickness decreasing toward the center of the beam). In some spans, beam haunches could curve from a beam depth near the columns of approximately seven feet to a midspan depth of approximately five feet in each span. The beams would be installed with one or two large mobile cranes. The connections between beams would be integrated with the crossheads using cast-in-place concrete. Job site post-tensioning operations would be accomplished for each beam line between expansion columns, in continuous three- to six-span structures, after the beam-to-beam concrete connections have cured for a minimum of three to seven days or more. The estimated time required to install the beams, align and secure them, add reinforcing and cast the connections between beams, is approximately six to eight days for every two beams once all the preparation work has been completed.

In station areas, where support columns are more frequent to support the station mezzanines, platforms and canopies as well as the guideway, the beam may have a minimum constant depth of approximately five feet.

Stage 7 – Cable Trays and Walkway Installation

There are several possible methods and details for installation of cable trays and emergency walkways along the guideway beams. One approach (shown in Volume 5, Appendix X of the Draft EIS) that is representative of potential impacts would be to attach emergency walkways to the beams using a telescoping man-lift or a crane. Installation of cable trays for electrical power and control cables may possibly be completed from above the street from supports attached to the guideway beams. A small crane would be used to lift materials up to the beam height. Automatic train control systems and power pick-up mechanisms would be attached to the beams.

Stage 8 – Roadways and Streetscape Construction

Following utility relocation, foundation construction, and column and beam installation, the roadway and streetscape surrounding each foundation location would be repaired or replaced as needed. Some concepts for how this work may be performed that are representative of potential construction impacts are depicted in Volume 5, Construction, Appendix X of the Draft EIS, Figures 15 and 16.

Roadway and streetscape repair could include installing curbs, sidewalks, and asphalt or concrete pavement. In areas where guideway columns have been constructed in existing parking lanes at the edge of the roadway, curb bulb-outs or straight-line curbs could be installed between the columns and the roadway. Trees or plantings removed to accommodate guideway construction would be replaced with appropriate trees or other plantings as guided by a Tree Planting Plan that SMP will develop in coordination with the City of Seattle and community members. In areas of the street where concrete paving slabs have been removed to construct foundations, columns, or utility trenches, appropriate repairs and/or replacements would be completed.

In areas where guideway columns are located in the center of the street, medians may be constructed between crossing street intersections. Medians would be shaped to provide left-turn and U-turn pockets where appropriate.

Lighting. Existing street lighting removed to accommodate guideway construction would be restored. In areas where the guideway structure obscures standard lighting, new lights may be attached to the bottom of the guideway beams. For certain areas along the Green Line alignment, a minimum light level under the guideway structure may be required. Existing traffic lights removed to accommodate construction activities would be restored.

4.17.1.3 Special Structures

Special structures would be used to support the guideway when long spans, curves, or cantilevered support systems are required. Examples of special structures may include: bents; eccentric (or offset) columns; switches and crossovers. (These terms are described in Appendix KK, Glossary, and are discussed and illustrated in Chapter 3, Project Description and Alternatives.)

In most cases, a column would be located directly under the center of the dual guideway beams. However, in areas where streets widen or a parking lane is eliminated to accommodate turning lanes, special structures such as eccentrically loaded columns or bent structures could provide a better structural solution. Eccentrically loaded columns and bent structures might also be required to support the guideway if it curves or travels diagonally through a street intersection, or where existing areaways or utilities under sidewalks restrict where foundations can be located. If an eccentrically loaded column cannot be accommodated, a special bent structure may be required. A bent structure consists of two columns supporting a girder approximately perpendicular to the dual guideway beams. The bent structure would typically straddle an entire street width, with columns that range from 36 to 48 inches in diameter or more located on or near the sidewalk.

Typical guideway beams would be centered about 12 to 16 feet apart. When approaching a center platform station, the beams would diverge to a distance up to 37 feet or more between beam centers. Special wide steel or concrete crossheads would be required to support these diverging beams and would require larger diameter columns and drilled shafts for support. These special column/crosshead elements may be required to be eccentric to the center point of the two diverging beams. If the adjacent streets allow, single columns may be used directly under the diverging beams.

Taller than normal columns and longer than normal beam spans would be required where the guideway beams traverse existing elevated roadways and roadway bridges. For example, taller columns and longer beam spans would be required at the point where the guideway crosses over the W Galer and W Garfield Street bridges in Interbay. Similarly, taller columns and longer beams would be required as the Green Line approaches the railroad tracks and SR 519 near the stadiums in the SODO Segment. Column and foundation size and depth would increase as the height of the guideway increases.

Switch and crossover structures would likely be supported on either a series of precast or cast-in-place bents or a cast-in-place beam with a continuous deck. A crossover would consist of two switches, each of which would be, conservatively, approximately 90 feet long for a total of 180 feet, although the size of a switch varies by the train technology used. A double crossover would consist of four switches and be approximately 360 feet long.

Crossover structures would typically be cast-in-place concrete. A double crossover would consist of four cast-in-place columns, with three longitudinal beams cast integrally with a continuous deck. The duration of construction of this element would be six to eight weeks and would include formwork, rebar casting, and formwork removal. A crossover structure without a continuous deck would be detailed differently, but the construction schedule would be about the same.

4.17.1.4 Stations

Construction in station areas could require demolition of existing buildings, relocation of utilities, and removal of existing sidewalks, curbs, and paving. Foundations for station and guideway support columns would likely be constructed using traditional spread footings, drilled shafts or driven piles, similar to those described for the guideway structure. Station support columns may be precast or cast-in-place concrete or steel.

New underground utilities would be provided for services required in the station, such as potable water, fire, power, sewer, storm drains, communications, and closed circuit television (CCTV). Irrigation piping could be constructed for landscaping as desired. Stations would be constructed to provide access to a mezzanine and/or platform levels via stairs, escalators and/or elevators. Station platforms would require a canopy to provide weather protection, railings around the outer sides of the platform and train access doors at the platform edge.

Mezzanine stations may require support structures on both sides of the street to support the mezzanine and access stairs. Vertically arranged (Iris) stations, which would support two levels of guideway beams, would require walkways cantilevered from the face of a building, with train access doors corresponding to the train door pattern. These walkways would have canopies and could be enclosed to protect passengers from inclement weather. The walkways may be supported by foundations and columns outside the building face, especially for very long walkways. Stairs, escalators, and elevators may be included in the building for vertically arranged stations.

4.17.1.5 Bridges

Ballard to Interbay/Magnolia Segments

The Green Line will require the construction of the Ballard Crossing, a new bridge over the Lake Washington Ship Canal. At the Lake Washington Ship Canal, the minimum vertical clearance required for ship navigation below a fixed bridge structure ranges from 120 to 125 feet. This clearance height will be determined by the U. S. Coast Guard during its public outreach and bridge permit process. The main span length required to clear the navigational channel width would be approximately 400 feet wide.

Greater minimum clearance may be required and final design would depend on an assessment of in-water impacts, shipping and potential mitigation. The bridge structure would be approximately 10 to 30 feet wide and would be designed to support one or two guideway beams attached to the bridge deck. The bridge structure would interface with a typical guideway structures at either end of the bridge structure at the points where the column heights exceed about 60 feet, or where span lengths may exceed 120 feet. Because this bridge would be a significant structure and of aesthetic importance, SMP is evaluating several bridge type options, including a segmental concrete box girder, a steel arch, and a cable-stayed bridge.

All three of the bridge types and the three locations being considered for the bridge would require the placement of columns in the water, but outside of the navigational channel. Barges or temporary work trestles would also be expected to be used for all three bridge types and locations. The box girder alternative would have nine to 11 in-water support columns, depending on main and flanking span length (250 to 450 feet), approach span length (100 to 300 feet), and alternative crossing location. The cable-stayed alternative would have four to eight in-water support columns, and the arch span would have six to nine columns. Construction methods for the support columns would include drilled shafts within a cofferdam, driven piles, or cast-in-place piles (with or without a cofferdam). Construction would take place either from barges or a temporary work trestle for each alternative. All alternatives would place the shoreward column a minimum of 50 feet from the ordinary high water line. The cable-stayed 900-foot main span alternative would place the first column 130 feet from the ordinary high water line. All alternatives should place the closest in-water column at least 100 feet away from the ordinary high water line. At the shoreline, the guideway would be at least 60 feet above the land on the south side and over 100 feet on the north side of the Ship Canal.

The segmental concrete box girder bridge would use box girders of varying depth to create haunched main and flanking spans of 250 to 450 feet with cast-in-place concrete columns supported by drilled shafts or pile-supported foundations. The main and flanking spans would use haunched box girder sections, while the bridge approaches may or may not use haunched spans. The segments of the bridge box girders would be precast off site in lengths of approximately 15 to 20 feet, and would be joined together at the bridge site using post-tensioning tendons. Segmental spans may be constructed using the balanced cantilever method, building out from the columns by alternately adding balanced segments on the back span and forward span, until the cantilevered portions meet at mid-span between the columns for a closure pour. This method was used to construct the existing West Seattle Bridge. Another method of constructing the segmental spans would use a temporary steel truss supported by the bridge columns to hang each segment of the span while post-tensioning of the entire span takes place.

The other bridge structures would have impacts similar to the column installation for the concrete box girder or the approach spans for an arch or cable-stayed structure. For a cable-stayed structure, precast segments would likely be lifted into place from a barge and then attached to the cable tendons. A steel arch bridge could also be built with prefabricated sections placed from the water below and bolted or welded in place. A concrete arch bridge would involve a great deal of cast-in-place construction using cantilevered support systems. While length of construction for each type of bridge would vary, construction is anticipated to take approximately 24 to 36 months or more depending upon work hours and conditions contained in regulatory approvals or permits. In-water construction would be staged to occur during work windows determined by resource agencies to protect fish habitat.

SODO/Chinatown International District/Pioneer Square Segment

In the SODO Segment, concrete or steel box girder bridges may be required for crossing over the existing S Atlantic Street Bridge, through the Safeco Field Station area, and over the proposed SR 519 Bridge, the I-90 on-ramps, the BNSF railway main tracks near the existing King Street Station and near S Lander Street, and the special long spans near Utah Avenue S and S Horton Street to allow for truck turning movements. The preliminary plan for column location in this area has spans ranging from 160 to 450 feet. The depth of the box girders may be between 14 and 18 feet for the longest spans. Spans could be either haunched or constant-depth girders.

West Seattle Segment

Two alternatives are identified for the Green Line crossing of the Duwamish River. Alternative 6.1 would construct a guideway atop the existing West Seattle Bridge. Alternative 6.2 would construct a new, monorail-only bridge adjacent to the north side of the existing West Seattle Bridge. Neither alternative is expected to involve permanent new structures in the East or West Duwamish River Waterways, although in-water work may occur in the East Duwamish in order to install temporary construction trestles to access the retrofit work. Work for the Duwamish crossing would occur over or near the water during the construction period and barges could be used temporarily in either of the Duwamish River Waterways. SMP has identified a modified box girder bridge as the most appropriate for the crossing.

At the West Seattle Bridge, Alternative 6.1 requires attachment of typical monorail columns to the top of the existing bridge, with sufficient height of the guideway beams to clear vehicular traffic below. The 375-, 590- and 375-foot spans of the high-rise West Seattle Bridge structure should accommodate a typical guideway structure with approximate span lengths of 100 to 200 feet between columns. The West Seattle Bridge's existing structure is a segmental concrete box girder, constructed using the balanced cantilever method. The superstructure of the high-rise bridge would be strengthened to carry the added dead, live, and seismic loads of the Green Line guideway using new diaphragms beneath the columns, and by adding post-tensioning and reinforcing steel to the existing box girders. Compared to concrete guideway elements, steel guideway beams, crossheads and columns might significantly reduce the loads applied to the existing structure, minimizing the construction work and costs of strengthening the existing superstructure.

The east approach to the West Seattle Bridge consists of two five-span structures, with WSDOT standard prestressed concrete girders and a cast-in-place concrete deck. Guideway beams deeper than the typical haunched beams would be required to span between new columns located at the existing columns, with spans ranging from approximately 154 to 164 feet. The depth required is approximately nine feet based on initial calculations. Steel monorail elements would be used to minimize the loads applied to the existing bridge crossbeams, thus minimizing costs to strengthen the crossbeams of the existing bridge. The guideway columns would be located near the center of each of the existing cast-in-place concrete column crossbeams, which would be strengthened to carry the added dead, live, and seismic loads of the monorail guideway, using external post-tensioning or reinforced concrete added to the sides or bottom of the crossbeams.

East Duwamish Waterway Construction Activities

Similar to other piers on the West Seattle Bridge on the non-box girder section of the bridge, the pier caps at two lines of piers located in the East Waterway (piers 25 and 26) would need to be retrofitted and strengthened. This will entail dowel and rebar installation, forming and concrete placement. Accessing this area is a challenge because the portion of the West Seattle Bridge over the East Waterway is

obstructed to both the north and south by the low-level railroad bridge immediately to the south and the low-level roadway bridge immediately to the north. Because of the close spacing of the piers for these bridges, it is not feasible to float a barge in to support work in this area. There are two ways that construction could be supported.

The first potential construction method would be to transport a barge or flexi-float/sectional barge by truck to the site and use a crane to place the barge in the water. The pier areas would then be accessed by shallow draft flexi-float barges, configured in a manner that would encompass a series of sections fastened together to make a stable work barge. Anchor lines would run to land and be secured to fixed points, commonly called deadmen anchors.

A platform would be constructed to reach from land to the barges for access for a crane, materials, etc. Another platform would be secured to a pier column above high water. This platform could have a gangway to the barge, fixed at the platform and able to move on the barge to allow for tidal action. The fixed column platform would have a stair tower constructed for personnel access to a work platform under the pier caps. Some temporary roadway work would also be required in order to access the area by truck.

The second potential construction method at the East Waterway would involve construction of a temporary trestle to access the retrofit work. The components of the trestle would include closed end piling in the range of twelve to eighteen inches in diameter, two piles per location and pile locations on thirty-foot centers for the width of the channel. It would also include steel dual pile caps, and h- beam bridge members supporting wood mats. The mats would be approximately twenty four feet wide and up to twelve inches in thickness. The trestle would not need to span the entire width of the waterway at any one time, so that access for the small craft that access this waterway could be maintained throughout the construction period.

The trestle would also include the appropriate safety equipment, such as hand rails, fire extinguishers, spill prevention barrels that would have oil booms and diapers enclosed, and hazardous waste containers to receive any item that needs containment. Life rings with ropes attached would be required at all work locations. After the trestle was put into place at each pile area, work platforms at the pier would be erected and attached to the columns so that the retrofit work at the pier caps could take place. After construction activities are completed, the trestle components will be removed, all piling extracted, and temporary footers if any removed, and the area will be restored to its pre-construction condition.

The west approach structure to the West Seattle Bridge uses WSDOT standard prestressed concrete girders and a cast-in-place concrete deck, similar to that of the east approach structure. However, the last two spans adjacent to the high-rise structure have spans of about 190 feet.

Alternative 6.2 would construct a new concrete box girder bridge north of the existing West Seattle Bridge, and crossing over the East and West Duwamish Waterways. This new segmental concrete box girder bridge would use haunched beams to create continuous 300- to 650-foot spans, with cast-in-place concrete columns supported by drilled shaft or pile-supported foundations. Bridge box girders would be precast off site in lengths of approximately 15 to 20 feet, and would be joined together at the bridge site using post-tensioning tendons. Segmental spans could be constructed using a balanced cantilever method or by using a temporary steel truss supported by the bridge columns to place the span. Foundations would use open- or closed-end driven steel pipe piles and cast-in-place concrete pile caps. Columns would be cast-in-place concrete.

4.17.1.6 Staging Areas

Constructing the Green Line will require temporary work and storage areas out of the right-of-way or the areas required for the stations or the Operations Center. (See Section 4.17.2.1 for a discussion of prospective construction staging sites for each segment.) These construction access and staging areas would provide for activities such as:

- a. Administration and labor parking.
- b. Construction trailers for storage and office space.
- c. Equipment storage (small cranes, trucks, backhoes, drill rigs).
- d. Material storage (aggregate, walkway assemblies, etc).
- e. Laydown and layout of work elements, pre-fabrication of construction support items including formwork, reinforcing steel, and safety barricades.
- f. Maintenance of construction equipment.

Many of these activities would also be expected to temporarily occur within the areas required for station sites, for the Operations Center, and in some instances on property required for guideways. For instance, equipment for construction of the stations and construction trailers for storage and field office space would be located on station sites where possible. The station sites may also be used for parking of guideway construction equipment.

The alternative Operations Center sites that were evaluated are also of sufficient size that they could serve as storage areas to accommodate larger pieces of equipment and storage and office trailers. The space required for major laydown areas, storage and fabrication may be greater than the space available for use in the selected Operations Center site, in which case the construction contractor could be required to secure available, appropriately zoned parcels or vacant land in reasonable proximity to the Green Line to accommodate storage and staging needs.

The location of staging areas would be expected to be in close proximity to the work activities each area supports, and potential sites are expected to be located in predominantly industrial areas. The contractor's methods of construction and sequence of work activities would influence the optimum locations and size for work areas needed by the contractor for efficient implementation of the work. The selection, acquisition, permitting, and approval of staging areas would be done so as to facilitate construction operations and minimize impacts to the community. In some cases, the station sites may be able to also provide staging not only for the station construction, but also for the adjacent guideway construction.

The size of staging areas would vary by the activity required for constructing nearby sections of the project. At work sites where the work activity is more involved and extensive (for instance, at station locations), a larger staging area would be required than at other locations along the guideway. Station location sites could provide some staging area capacity but may need to be augmented with property in close proximity that could be used by the contractor. Typical staging areas could be one-half acre to accommodate a station or special structure, while smaller staging areas might serve a section of guideway construction that is not adjacent to a station or special structure.

The time during which staging areas would be in use would be a function of the contractor's work plan, sequence, and duration of activities. Estimated durations for uses of staging areas serving stations and possibly guideway construction would be approximately one year and for uses of staging areas serving bridge construction (including bridge structures in the Interbay and SODO Segments) and guideway segments through Downtown Seattle would be approximately two to three years. Shorter-term (up to 6-month) staging areas may be required to serve guideway construction in areas where use of a station construction staging area would be inconvenient or unfeasible.

Green Line concrete needs in general are anticipated to be provided by existing sources, and SMP does not currently anticipate the need for a concrete batch plant in staging areas with the exception of a possible precast concrete construction yard, although if one is required it could be located in available, industrially zoned land. Preliminary review indicates a number of appropriately zoned parcels are available without displacement impacts. Other concrete needs would be assumed to be provided by existing sources. If a precast yard to support the Green Line project is required, the facility would include areas for storage, column fabrication, machinery, and a concrete batch plant. Since the installation of guideway columns and beams would be phased, it may be possible to have a precast yard in an outside location, with components hauled to the project site as necessary.

A preliminary estimate of the quantity of staging areas that could be needed by contractors is provided in Table 4.17-2.

Table 4.17-2. Summary of Estimated Construction Staging Areas
(Final numbers to be determined by contractor)

Type of Staging Area	Estimated Numbers, Sizes, and General Locations of Staging Areas
Stations	Up to 19; locations along the entire alignment
Special structures & bridges	Approximately six, located at the Ship Canal and Duwamish Waterway, and on the overflying of roadway bridges and railroad tracks in Interbay and SODO
Guideway staging areas	Approximately four areas, from ½ to 1 acre, likely to be located in the Ballard/Interbay industrial areas, the SODO industrial area, and West Seattle near the West Seattle Bridge.
<i>Total</i>	<i>29</i>

4.17.2 Transportation

Green Line construction activities would result in lane closures and increased truck traffic along the Green Line alignment, station areas, and staging areas.

In accordance with the City of Seattle traffic control manual, work on arterial streets requires prior approval for each specific aspect of construction and lane usage. In Downtown Seattle, SMP will coordinate with the City of Seattle on special events, holiday construction, and other activities.

Temporary Lane or Street Closures

Temporary lane or street closures would be expected, primarily for the streets that the alignment would follow, and some closures would require detour routes. The extent and location of these temporary operational changes would depend on the final location of the guideway alignment, the size of foundations, and type of equipment required.

Guideway construction in or near the existing curb lanes of any streets could close that lane and potentially one adjacent lane during construction. Additionally, for equipment movement, utility relocation, movement of guideway precast elements into the work site, and placing those elements, additional lanes may be needed on a short-term basis. Most of these multi-lane closures would likely occur during weekday off-peak hours or on weekends.

Guideway construction in the center of streets would require closure of at least each lane adjacent to the construction and could require closure of two or three lanes dependent on the street layout. Similarly, movement of equipment, utility relocation, and placing elements of the guideway may require additional lanes to be closed temporarily.

In general, the roadways that any of the Green Line alignment alternatives would follow may have lane closures and restrictions that would affect several blocks at any one time. For longer segments of the alignment, some parts of the roadway would experience intermittent restrictions for up to two years.

Shorter segments and roadways that the Green Line would cross may have shorter duration restrictions, typically no more than intermittently for six months. Techniques shall be developed to reduce the traffic lane closures, and if so, they would be included in detailed traffic management plans for each construction segment.

Green Line construction may require temporary bus route relocations. SMP will work with Metro to identify and develop a plan for any bus impacts resulting from construction.

4.17.2.1 Impacts

Construction Traffic and Parking

Construction workers and truck trips would constitute the majority of new trips generated by construction activities. The largest volume of employees at any given site is anticipated during construction of the station structures, where several dozen construction workers could be active at one time within a given two-block segment. Contractors and construction workers parking near designated construction areas could reduce the availability of on-street parking during heavy construction periods, by occupying or otherwise blocking access to parking normally available to the public.

Routes immediately parallel to the Green Line alignment, including some residential streets in the Ballard and West Seattle segments, could also experience temporary traffic increases due to added traffic from temporary detours. The additional diverted traffic would generally be for limited durations over short segments, and mostly during off-peak periods. Any use of non-arterial streets for truck access would require prior approval from SDOT.

Truck traffic would occur primarily between staging areas and nearby highways (e.g., I-5, SR 99, I-90) via arterial roadways. All arterials are designated by the City of Seattle's Comprehensive Plan as truck streets to serve local truck traffic. However, even with careful designation of haul routes, access to construction areas could require using non-arterial streets in certain areas.

A more detailed discussion of where these construction activities, lane closures, and truck trips may occur within each segment follows.

Segment 1: Ballard Segment

In the Ballard Segment, construction of alignment Alternative 1.1 or the Preferred Alternative (Alternative 1.1(s)) which would place columns on the west side of 15th Avenue NW, would require closure of the southbound curb travel lane/off-peak parking lane and possibly an adjacent travel lane. This would limit the total number of southbound travel lanes to one or two during construction periods. No traffic impacts would be expected in the northbound travel direction. Heavy construction should be avoided during the weekday a.m. peak hour to minimize impacts to traffic operations.

Alternative 1.2 would involve construction in the center of 15th Avenue NW, which could require closure of two or three lanes (including a center two-way left turn lane). This would likely limit travel on 15th Avenue NW to one or two travel lanes in each direction during construction.

In the areas where guideway construction might need to be augmented by additional staging areas, the prospective sites listed below are typical of locations that contractors might choose for the Ballard Segment:

North of Ballard Crossing:

Option 1 – On a portion of the NW Market 3A Station site in the northwest quadrant of the NW Market Street/15th Avenue NW intersection.

Option 2 - Three parcels bordered to the east by 15th Avenue NW, to the North by NW Leary Way and to the South by NW Ballard Way.

Option 3 - Potentially two sets of parcels, due to location and size. One set is bordered to the east by 15th Avenue NW, to the north by NW Ballard Way and to the south by NW 46th Street. A second set is bordered on the north by NW 46th Street, to the east by 15th Avenue NW and to the southwest by Shilshole Avenue NW.

Option 4 – Potentially two sets of parcels. One set is bordered to the west by 15th Avenue NW, to the north by NW Ballard Way and to the south by NW 46th Street. A second set is located east of 15th Avenue NW south of Shilshole Avenue NW.

Potential staging areas associated with construction of the Ballard Crossing are discussed in greater detail in the Project's Joint Aquatic Resources Permit Application (JARPA) which has been incorporated by reference into this Final EIS.

Truck traffic would occur primarily between these staging areas and nearby highways via arterial roadways. Access from the north could be provided primarily by I-5, Aurora Avenue N/SR 99, and NW 85th Street. NW Leary Way and N 36th Street could provide primary access to the southern portion of the Ballard Segment.

Segment 2: Interbay/Magnolia Segment

In the Interbay/Magnolia Segment, construction of Alternative 2.1 (the Preferred Alternative) would require closure of the west side of 16th Avenue W (and possibly the entire width of 16th Avenue W for some portions of construction) and 15th Avenue W, requiring closure of the southbound curb travel lane and possibly an adjacent travel lane on 15th Avenue W. On 16th Avenue W, this would limit travel in the northbound and southbound directions to one shared lane. This would not be a significant impact, as traffic volumes along 16th Avenue W are currently very low. On 15th Avenue W, this would limit the number of southbound travel lanes to one or two during periods of construction. No traffic impacts would be expected in the northbound travel direction. Where possible, heavy construction should be avoided during the weekday a.m. peak hour to minimize impacts to southbound traffic operations on 15th Avenue W. With Alternative 2.1, construction would also occur in the center of Elliott Avenue W, which could require closure of two or three lanes (including a center two-way left turn lane). This would likely limit travel to one or two travel lanes in each direction during construction periods.

With Alternative 2.2, construction of the guideway along 15th Avenue W would occur in the center of the street, requiring the closure of two or three travel lanes (including a center two-way left turn lane). This would likely limit travel to one or two travel lanes in each direction during construction periods. Where possible, heavy construction should be limited to weekday off-peak hours or weekends to minimize impacts to traffic operations. Construction of Alternative 2.2 would also require closure of one or two travel lanes on the west side of Elliott Avenue W. No traffic impacts would be expected in the

northbound travel direction. Where possible, heavy construction should be avoided during the weekday a.m. peak hour to minimize impacts to southbound traffic operations on Elliott Avenue W.

In the areas where guideway construction might need to be augmented by additional staging areas, the prospective sites listed below are typical locations that contractors might choose for the Interbay Segment:

South of Ballard Crossing:

There are four possible construction staging areas located on the south side of the Ballard Crossing. Two of the locations are west of the existing Ballard Bridge on Fishermen's Terminal property north of W Emerson Street. The other two are located east of the existing Ballard Bridge and 15th Avenue W; one location is north of W Nickerson Street and the second location is south of W Nickerson Street in the 15th Avenue W/W Emerson Street/W Nickerson Street interchange area. Potential staging areas associated with construction of the Ballard Crossing are discussed in greater detail in the JARPA, which has been incorporated by reference into this Final EIS.

Between W Gilman and W Galer Streets:

Between W Armory Way and W Howe Street, there are several possible staging areas. *Option 1* is the corner of W Armory Way and 15th Avenue W. *Option 2* extends south along 15th Avenue W from the Option 1 location.

Between W Galer and W Harrison Streets:

Option 1 - There is vacant land adjacent to the proposed station site, directly north of the Chen's Village site at 544 Elliott Avenue W. *Option 2* is south of W Lee Street, if the required site does not need to be adjacent to the station.

Truck traffic would occur primarily between these staging areas and nearby highways via arterial roadways. Aurora Avenue N/SR 99, W Nickerson Street, Elliott Avenue W, and 15th Avenue W could provide primary access for this segment.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

In the Queen Anne/Seattle Center/Belltown Segment, construction of Alternatives 3.1 and 3.3 would occur on the south side of W Harrison Street and in the center of Fifth Avenue. Construction of the alignment along W Harrison Street would displace parking spaces on the south side of the street (up to 48 spaces) and would require closure of the south travel lane. If parking is temporarily removed on the north side of the street, one travel lane in each direction could likely be maintained during construction. If possible, heavy construction should be avoided during the weekday peak hour to minimize delays caused by construction equipment and vehicles in the area. Along Fifth Avenue, construction activity would occur in the middle of the roadway and would likely require closure of up to two southbound travel lanes. This would likely limit traffic to one or two lanes in the southbound direction during construction periods. Where possible, heavy construction should be limited to weekday off-peak hours or weekends to minimize impacts to traffic operations. Parking would likely need to be removed from both sides of the street during guideway alignment construction.

Construction of Alternative 3.2 would affect the north side of W Harrison Street, the east side of Warren Street, the north side of Mercer Street and the west side of Fifth Avenue through Belltown. Construction activity on all these streets would likely require closure of one travel lane on all of these streets and could temporarily displace on-street parking along at least one side of the street along Harrison Street, Warren Avenue, and Fifth Avenue. Along Harrison Street, Warren Avenue, and Fifth Avenue, travel lanes may be able to be retained if parking is temporarily removed from both sides of these streets. With Option

3.2.1, removal of the existing monorail in the center of Fifth Avenue would likely require temporary full closures of affected sections of Fifth Avenue.

Alternative 3.5 would result in the same construction impacts on W Harrison Street and Fifth Avenue through Belltown as Alternatives 3.1 and 3.3. Additional construction activity would occur on both sides of Second Avenue N (for straddle bents), and on the south side of Denny Way. Construction activity along these streets would likely require closure of one or two travel lanes on Second Avenue N and Denny Way. On Second Avenue N, one travel lane could likely be maintained during most construction activities, though some full closures may be required during heavy construction periods. This would not likely result in significant traffic circulation impacts. Denny Way could be limited to one travel lane in each direction during construction.

The Preferred Alternative for this segment is a combination of Alternative 3.1 on W. Harrison Street, through Seattle Center and the EMP and on Fifth Avenue N north of Denny Way; and Alternative 3.2 on Fifth Avenue between Denny Way and Stewart Street.

Primary arterial access for construction truck traffic in this segment could be provided via Mercer Street, Western Avenue, Elliott Avenue, and Aurora Avenue N/SR 99.

Segment 4: Downtown/Pioneer Square Segment

In the Downtown/Pioneer Square Segment, construction of the guideway would occur on Stewart Street and Second Avenue. For all alternatives, construction along Stewart Street would primarily occur on the south side of the street and would likely require closure of one or two travel lanes and displacement of on-street parking from both sides of the street. This would limit westbound travel to two lanes of traffic during most construction periods.

With Alternative 4.1 (the Preferred Alternative), construction activity along Second Avenue would occur on the west side of the street, which would require closure of the bus-only/off-peak travel lane and possibly close an additional travel lane. This would limit southbound travel to two or three lanes for vehicles and buses. An additional through lane may be provided during most periods of construction if parking is displaced from the east side of Second Avenue.

Alternative 4.2 would result in the same construction impacts along Second Avenue south of Marion Street. North of Marion Street, construction would occur on the east side of the street, which would displace on-street parking and potentially require closure of a southbound through lane.

With Alternatives 4.3 and 4.4, construction activity would occur in the roadway median and would likely require closure of up to two additional southbound travel lanes. This would likely temporarily displace on-street parking on both sides of the street and would require closure of two or three travel lanes. This would limit traffic to one or two lanes (shared by buses and passenger cars) in the southbound direction during construction periods. Some full closures may be required during heavy construction periods. Alternative 4.4 East of Center is similar to 4.2.

E Marginal Way/Alaskan Way S, the Alaskan Way Viaduct, and Yesler Way could serve construction truck traffic in the Downtown Segment.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Construction traffic impacts in the SODO/Chinatown International District/Pioneer Square Segment would differ for each alternative, depending on the location of the guideway on Third Avenue S, S Lander Street, Utah Avenue S, First Avenue S, and S Horton Street. With Alternative 5.1, construction of the guideway would occur on the east side of Third Avenue S, the north side of S. Lander Street, the west

side of either Utah Avenue S (Alternative 5.1.1) or First Avenue S (Alternative 5.1.2), and on the north side of S Horton Street. This would likely require closure of one travel lane in most locations and up to two travel lanes during periods of heavy construction. On-street parking would likely be displaced on one or both sides of these streets to maximize through lane capacity. Temporary full closures could occur along Third Avenue S, Utah Avenue S and/or S Horton Street during periods of heavy construction without significant impacts to traffic congestion.

Construction traffic impacts associated with Alternative 5.2 or the Preferred Alternative (Alternative 5.2(s)) would be similar to Alternative 5.1.1 along Utah Avenue S and S Horton Street. On Third Avenue S, construction activity would take place on the west side of Third Avenue S, which would likely displace on-street parking and close the southbound travel lane. At least one travel lane could likely be retained during most construction activities; however, temporary full closures could occur during periods of heavy construction without significant impacts to traffic congestion.

In the areas where guideway construction might need to be augmented by additional staging areas, the prospective sites listed below are typical locations that contractors might choose for the SODO Segment:

Near S Holgate Street

In the area of the Safeco Station, the proposed station site itself is the best location for construction staging. In the vicinity of S Holgate Street, the west side is all railroad operating property, making properties on the east side of Third Avenue S the only possible staging sites.

Option 1 – On a portion of the Lander 3 Station in the northeast quadrant of the S. Lander Street/First Avenue S intersection.

Option 2 - North of S Holgate Street there are five properties, including some owned by the State.

Option 3 - Five parcels south of S Holgate Street.

East side approach to West Seattle Bridge

Option 1 - On the south side of S Spokane Street opposite from Terminal 25.

Option 2 - At Terminal 104, just west of Option 1.

Truck traffic would occur primarily between these staging areas and nearby highways via arterial roadways. This segment could be served by Yesler Way, S Dearborn Street, Fifth Avenue S, S Royal Brougham Way, E Marginal Way/Alaskan Way S, and the Alaskan Way Viaduct.

Segment 6: West Seattle Segment

Construction traffic impacts in the West Seattle Segment would differ for each alternative, depending on the location of the guideway. Alternative 6.1 would locate the guideway on the center of the West Seattle Bridge, west side of Delridge Way SW, the north side of SW Andover Street, the north side of SW Yancy Street, either the northwest side (Alternative 6.1.3) or southeast side (Alternative 6.1.4) of Fauntleroy Way SW, the north side of SW Alaska Street, and the west side of 42nd Avenue SW. This would likely require closure of one travel lane in most locations and up to two travel lanes during periods of heavy construction. On-street parking would likely be displaced on one or both sides of these streets to maximize through lane capacity. With Alternative 6.1, construction of the guideway on the West Seattle Bridge would likely require the closure of two lanes of traffic. This could significantly affect traffic operations during weekday peak hours. In addition, construction activity along SW Avalon Way and

California Avenue SW would occur in the center of the road with Alternative 6.1, which would require closure of two or three travel lanes (including the center two-way left turn lane), or on the west side (Alternative 6.1.6) which would likely maintain one travel lane in each direction, but temporarily close the center two-way left turn lane. On-street parking would need to be displaced to maintain any through traffic along these roadways. During some periods of construction, travel would likely be restricted to one direction of travel only. Full roadway closures may also occur during periods of heavy construction.

With Alternative 6.2, construction activity would occur on a new, monorail-only bridge near the existing West Seattle Bridge, the south side of SW Andover Street, the east side of 35th Avenue SW, the east side of 44th Avenue SW, and the east side of California Avenue SW. This would likely require closure of one travel lane in most locations and up to two travel lanes during periods of heavy construction. On-street parking would likely be displaced on one or both sides of these streets to maximize through lane capacity. With Alternative 6.2, construction of the new bridge across the Duwamish waterway would likely require some temporary partial closures of one or two travel lanes along Spokane Street. During most periods of construction activity, two directions of travel could likely be provided. Any full closures should be limited to off-peak and/or nighttime periods. Alternative 6.2 would also require construction activity to occur in the center of SW Avalon Way and SW Alaska Street (Construction with Alternative 6.2.2 would occur on the north side of SW Alaska Street, resulting in impacts similar to Alternative 6.1 in that area.). Alternative 6.2.2 would also require construction in the center of 35th Avenue SW between SW Avalon Way and SW Alaska Street. On all streets with center construction, two or three travel lanes would likely be closed during construction. It is likely that at least one travel lane in each direction could still be provided in most areas if on-street parking is displaced during the construction period. In periods of heavy construction, travel may be limited to one direction.

With Alternative 6.3(s) (Delridge North Subsegment), construction activity would occur on the south side of SW Spokane Street and the center of Avalon Way SW. Construction of the Alternative 6.3(s) guideway and Delridge 3 station would likely require temporary partial closures of one or two travel lanes on the eastbound section of SW Spokane Street between Avalon Way SW and Delridge Way SW. This would likely result in temporary closure of the eastbound transit-only lane.

With Alternative 6.4/6.4(s) (Andover/Yancy Subsegment), construction activity would occur on the south side SW Andover Street and north side of SW Yancy Street.

With Alternative 6.5 (Genesee Subsegment), construction activity would occur on the west side of Delridge Way SW and north side of SW Genesee Street.

Construction activity would likely require closure of one travel lane in each location for these alternatives.

The Preferred Alternative for this segment is a combination of:

- Alternative 6.1(s) on the West Seattle Bridge to Delridge Way SW including Option 6.1.1(s) – Past Pigeon Point.
- Alternative 6.3(s) in the Delridge Way SW to SW Avalon Way area.
- Alternative 6.2.2 in the center of 35th Avenue SW to the north side of SW Alaska Street.
- Alternative 6.1 on the west side of 42nd Avenue SW in the Alaska Junction area.
- Alternative 6.1.6(s) with a single beam configuration on the west side of California Avenue SW to the Morgan Junction 1A Station.

In the areas where guideway construction might need to be augmented by additional staging areas, the prospective site listed below is typical of locations that contractors might choose for the West Seattle Segment:

West side approach to West Seattle Bridge:

Only one apparent property (Riverside Mill LLC at 3800 W Marginal Way SW) suitable for construction staging exists on the west side of the West Seattle Bridge.

Potential staging areas are discussed in greater detail in the JARPA, which has been incorporated by reference into this Final EIS.

Truck traffic should occur primarily between staging areas and nearby highways via arterial roadways with some potential for truck traffic on neighborhood streets. In addition to the West Seattle Bridge, primary access routes could include SW Spokane Street, W Marginal Way and E Marginal Way.

Impacts to Rail Activity

Construction of the Green Line portions that overfly the Burlington Northern Santa Fe (BNSF) main line or Union Pacific (UP) tracks would require placement of pre-cast or cast-in-place guideway sections to span those railroad tracks. This construction operation could conflict with rail transportation and create delays in rail transportation unless construction timing is coordinated with BNSF, UP, Amtrak, Sound Transit, and franchisee Ballard Terminal Railroad.

Impacts to Navigable Waterways

For all bridge types being considered for the Ballard Crossing, construction of bridge elements would require barging of bridge components to the site for bridge construction. Because the Ship Canal is a busy waterway, these construction barge operations have the potential to interfere with marine navigation in the Ship Canal and in the Port of Seattle's Fishermen's Terminal area. SMP will coordinate the timing of construction operations with the U. S. Coast Guard, City of Seattle, and Port of Seattle in order to minimize impacts on navigation.

Ballard Segment

In addition to the alignment alternatives, there are three bridge types being considered: box girder, cable-stayed, and arch. For construction of a new box girder or cable-stayed bridge, barges would likely be used for transporting precast box girder segments to the site.

West Seattle Segment

With Alternative 6.1 and the Preferred Alternative, temporary work platforms would be suspended from the underside of the existing box girders on the West Seattle Bridge to provide access to form, reinforce, and pour the new concrete diaphragms. These platforms may encroach 10 to 15 feet or more into the top of the navigational channel clearance envelope. This could lower the vertical navigational clearance to 125 to 130 feet over mean high water. A barge may be used for occasional work shifts beneath the bridge to crane lift materials to the underside of the bridge for work on new diaphragms. Timing of the use of temporary work platforms would need to be coordinated closely with marine users in order to minimize impacts. Timing and location of barge use would likewise be scheduled to minimize marine impacts. A temporary work trestle may be used in the East Waterway for construction activities in that area.

Impacts to Air Transportation

Construction of the Green Line is not expected to significantly affect air transportation in any of the Green Line alignment segments.

4.17.2.2 Mitigation

Mitigation for Construction Traffic and Parking

All mitigation measures would comply with regulations governing construction traffic control and construction truck routing. SMP would finalize a detailed Construction Traffic Management Plan in close coordination with SDOT, Metro, and other affected agencies and organizations. Potential mitigation measures for traffic and freight impacts due to Green Line construction include the following measures:

- Secure all work areas using appropriate pedestrian and vehicle traffic barriers, security fencing, and flaggers to provide for worker, pedestrian, and traffic safety.
- Coordinate lane closures with the City of Seattle's traffic control section for appropriate times and lane takes. In some cases, the police department may be required to monitor construction activities and direct traffic at intersections affected by lane closures.
- Schedule traffic lane closures during off-peak hours to minimize delays during periods of higher traffic volumes as much as possible.
- Coordinate with Metro Transit and Sound Transit to ensure that construction impacts and disruptions to bus facilities and service would be minimized. Post informative signage well before construction at existing transit stops that would be affected by construction activities.
- Follow standard construction safety measures, such as installation of advance warning signs, highly visible construction barriers, and the use of flaggers.
- Post advance notice signs prior to construction in areas where surface construction activities would affect access to surrounding businesses.
- Provide regular, written updates to assist public school officials in providing advance and ongoing notice to students and parents concerning construction activity near schools.
- Coordinate street sweeping services in construction areas with construction activity, particularly areas with surrounding residential and retail development.
- Work with the City's solid waste contractors to coordinate alternative collection locations and times in order to minimize potential impacts to solid waste collection operations during construction of the Green Line.
- Use lighted or reflective signage to direct drivers to truck haul routes, to ensure visibility during nighttime work hours.
- Use temporary reflective truck prohibition signs on streets with a high likelihood of cut-through truck traffic.
- Cover potholes and open trenches during construction hours where possible, and use k-rail or other protective barriers to protect drivers from trenches remaining open.
- Develop a multimedia public information program (e.g., print, radio, posted signs, and electronic web page) to provide information regarding street closures, hours of construction, business access, and parking impacts.

- Identify measures to reduce the need of street parking by construction workers with carpool, bus pass, or designation of on- or off-site parking to minimize neighborhood parking impacts.
- Provide temporary parking to mitigate loss due to construction staging or work activities, as appropriate.
- To the extent possible, limit work in highly congested locations to two to four blocks to minimize disruption to traffic, bus and pedestrian circulation, as well as business access.
- Schedule construction activities to minimize impacts to traffic operations.

SMP and/or its contractors would work with City of Seattle staff to develop refined truck routing plans as part of final engineering and permitting. Final engineering and permitting would include coordination with City of Seattle staff and the Washington State Department of Transportation (WSDOT) so that streets and highways were adequately signed and any necessary traffic control measures installed. All trucking in Downtown Seattle would require permits to operate between the hours of 6:30 a.m. and 7:00 p.m.; all over legal loads are restricted in Downtown Seattle during these hours. SMP or its contractors would obtain prior approval for trucking activity associated with construction of the Green Line.

Pedestrian access to businesses should be maintained during business hours to the extent possible. In addition, construction near areas heavily used by pedestrians, such as the Seattle Center, Seahawks Stadium, Safeco Field, and key pedestrian facilities such as the Weller Street pedestrian overpass near King Street Station should be coordinated to avoid special events or other time periods when pedestrian activity is particularly high.

Traffic lights and trolley bus wires would be temporarily moved, as needed, during construction of the Green Line guideway. Locations where trolley wires may be affected during the construction period include the following:

- NW Market Street at 15th Avenue NW
- Fifth Avenue N
- First Avenue N and W Harrison Street
- Second Avenue between Pine and Pike Streets
- Stewart Street between Second and Fifth Avenues
- Second Avenue and S Main Street (and Waterfront Street Car)
- S Jackson Street at Third Avenue S
- Second Avenue and James Street
- Second Avenue and Cherry Street
- Second Avenue and Madison Street
- Second Avenue and Marion Street
- Second Avenue and Union Street

For areas in which trolley bus service could be affected, SMP will coordinate with Metro to develop mitigation measures, which could include two- or three-day weekend closures, rerouting of trolley wires, mechanisms to push trolley buses through intersections, or temporary use of diesel buses.

SMP will work with Metro Transit and Sound Transit to ensure that construction impacts and disruptions to bus facilities and service are minimized; however, transit stops and layover zones may need to be

temporarily relocated due to lane closures in some areas. The City of Seattle Department of Transportation (SDOT) would need to approve any specific locations in relation to moving any bus stops or layover zones.

In general, lane closures would be coordinated with the City of Seattle's traffic control section for review and approval of specific time periods when lane reductions are necessary. Where possible, construction activity along affected roadways should be limited to weekday off-peak hours or weekends to minimize impacts to traffic operations. In some cases, the police department may be required to monitor construction activities and direct traffic at intersections affected by lane closures. Mitigation measures are also discussed in Chapter 5.

Mitigation for Rail Activity

SMP would coordinate construction timing with BNSF, Amtrak, UP, franchisee Ballard Terminal Railroad, and Sound Transit to minimize the possibility for delays in rail transportation due to construction over tracks. SMP has designed long span guideways to mitigate any impacts to rail activity during construction or operations.

Mitigation for Navigable Waterways

Ballard Segment

Barging should be coordinated, as necessary, to avoid conflicts with existing vessel traffic and the Muckleshoot Tribe's peak fishing season. Construction of the arch bridge alternative could also require barging or could require the placement of temporary false work bents in the waterway, which could be placed to avoid impacts to navigational clearance envelopes.

West Seattle Segment

For construction of the new bridge with Alternative 6.2, barges are recommended for transporting precast box girder segments to the site. Barging should be coordinated, as necessary, to avoid conflicts with existing vessel traffic. Another method may be to use temporary trestles, which would be coordinated to minimize conflicts with vessel traffic and the Muckleshoot Tribe's peak fishing seasons.

Mitigation for Air Transportation

SMP would coordinate with the FAA during construction and/or modification of bridges.

4.17.3 Displacements and Relocation

4.17.3.1 Impacts

Property needs for the construction and operation of the Green Line station, guideway, and Operations Center alternatives are discussed in Section 4.2, Displacements and Relocation. Construction contractors would also be expected to require construction staging areas outside of the properties evaluated in Section 4.2. Construction staging areas are described in Section 4.17.1.6, and identified by general location in Section 4.17.2.1.

While the location and size of candidate sites may vary by segment and the contractor's approach, some sites would need to be at least one-half acre, which could require several adjacent parcels in some locations. In most cases, the contractor would be responsible for obtaining the use of the land required for staging, although there is the potential that the SMP could itself secure the use of the property through

acquisition. Displacement and relocation of existing uses could be involved, although preliminary review indicates that a number of appropriately zoned parcels are available and would not require displacement. All candidate sites evaluated in the EIS are located in primarily industrial/commercial use areas along the Green Line alternative alignments. Up to 15 parcels could be required for temporary staging, including the ranges of locations and uses described below.

- Ballard: two to three adjacent parcels, including vacant parcels, parcels with warehousing uses, and parcels housing small industrial businesses. One possible location is a portion of the NW Market 3A station site in the northwest quadrant of the NW Market Street/15th Avenue NW intersection. Other locations include parcels on the north side of the Ship Canal east and west of 15th Avenue NW described previously in Section 4.17.2.1.
- Interbay/Magnolia: a portion of Fishermen's Terminal property owned by the Port of Seattle, including an area currently vacant; other possible locations include two to four adjacent parcels housing currently vacant warehouses, vacant properties, and properties with planned construction of other projects. Several marine-dependent businesses could be displaced. Impacts to them are discussed in more detail in Section 4.2, Displacements and Relocation. Other locations include parcels on the south side of the Ship Canal east of 15th Avenue W described previously in Section 4.17.2.1.
- SODO/Chinatown International District/Pioneer Square: one possible site is on a portion of the Lander 3 station site and two possible sites near S Holgate Street with up to five adjacent parcels, with uses including bank and credit union branches or offices, a restaurant, surface parking, and equipment and truck rental businesses. A site on Port of Seattle property housing industrial uses, or an area with buildings currently planned for demolition by the Port is also possible for this use.
- West Seattle: two large adjacent parcels near the west side of the approach to the West Seattle Bridge, housing a mill and a transportation company.

4.17.3.2 Mitigation

Mitigation of property acquisition and displacement impacts is discussed in Section 4.2, Displacements and Relocation and in Chapter 5, Mitigation Program.

4.17.4 Land Use and Neighborhoods

In general, direct construction impacts include (1) short-term use of property for construction staging, job-site office facilities, construction worker parking; (2) traffic congestion, lane closures, sidewalk closures, and other access restrictions or detours that would affect vehicle, pedestrian, or bicycle access; and (3) loss of adjacent on-street or off-street parking. Temporary construction activities could affect access and parking to some businesses and residences along and within the immediate vicinity of the alignment. Temporary impacts to off-street parking areas could require replacement parking or other mitigation to avoid business impacts. Construction impacts could include localized increases in vehicle traffic, dust, noise, construction lighting, and utility disruptions. It is anticipated that construction impacts would occur periodically and intermittently throughout an average four-month construction cycle within each block along the alignment.

Segment 1: Ballard Segment

Impacts Within a Block of the Alignment

Construction impacts would be similar under each alignment alternative, although alignment Alternative 1.2 could have more traffic impacts. Relocation of utilities and placement of columns and guideway

beams along 15th Avenue NW would result in temporary disruption to local businesses, particularly on the west side of the street. Neighborhood residents and business patrons would also experience noise and dust associated with construction activities. Construction of either alignment alternative would also result in temporary disruption of vehicular and pedestrian traffic associated with relocation of utilities and placement of columns and beams. However, construction of Alternative 1.2 (Center of 15th) would likely be more disruptive because travel lane closures would be more extensive and affect both travel directions. Disrupted access to some businesses could occur. Construction of the west bridge alternatives is not expected to have significant adverse land or shoreline impacts, although some business displacement could occur (see Section 4.2 Displacements and Relocation). However, construction of the east bridge alternative could have an adverse impact on use of the 40th Street boat launch depending on the route used by construction traffic.

Impacts Within 1/4 Mile of Stations

Crown Hill Station

Construction impacts for the station alternatives would be similar, including temporary rerouting of traffic and impacts to business activity resulting in short-term economic disruption. Construction of Crown Hill 1 and 1A could have the greatest impact on the residents of the apartment building immediately to the west, particularly construction noise. Most station construction activity is expected to occur during the day. Construction of Crown Hill 2 could have greater impact to parking to the extent the Safeway site is used.

NW 65th Station

Construction impacts for all station alternatives would be similar to those for Crown Hill. Construction of a station at the NW 65th 2 location, however, would be more disruptive to students and vehicular traffic than the NW 65th 1, 1A, and 1B locations. Traffic would likely require some rerouting to nearby arterial streets and students and staff at Ballard High School might experience temporary noise impacts.

Market Station

Construction impacts for each station alternative would be similar to those for Crown Hill. Construction of Market 2, however, could be more disruptive to traffic, with utility relocation and construction occurring in the center of 15th Avenue NW.

Segment 2: Interbay/Magnolia Segment

Impacts Within a Block of the Alignment

Construction impacts would also be similar under each alignment alternative, including noise associated with construction activities. Relocation of utilities and placement of columns and guideway beams along 15th Avenue W could result in temporary disruption to local businesses, particularly on the west side of the street. Alignment Alternative 2.2 using 15th Avenue W could result in more traffic disruption in the vicinity of Dravus station than Alternative 2.1, which would use 16th Avenue W to reach Dravus station. The operations of certain maritime businesses, such as Fishing Vessel Owners Marine Ways, Inc. could be affected by construction staging or other activities for the West Bridge Connection (Alternative 2.1.1).

Impacts Within ¼ Mile of Stations

Dravus Station

Construction impacts for all station alternatives would be similar to impacts described previously. However, traffic using the 15th Avenue W access ramps at the Dravus 2 station location would likely experience some delay during station construction.

Howe Station

Construction impacts for all station alternatives would be similar to impacts described previously. Construction of a center station (Howe 2), however, would likely cause more disruption to traffic flow, whereas construction on the west side (Howe 1 or 1A) would primarily be off-street.

Interbay Operations Center

Construction impacts are expected to be minimal given the site's size, character, and neighborhood. However, Interbay P-Patch users could experience some noise and dust during the construction period, although this impact would be mitigated as mentioned in Section 4.17.2. The Northwest Center would also be displaced (see Section 4.2 Displacements and Relocations). Adjacent uses could experience some inconvenience due to construction traffic and guideway construction in the right-of-way.

Prospect Station

Construction impacts are expected to be minimal given the predominance of current commercial, manufacturing, and warehousing uses in the neighborhood. These land uses generally have a lower sensitivity to construction activity compared to residential or institutional uses such as schools or medical facilities.

Elliott and Mercer Station

Construction impacts for each station alternatives would be similar to impacts described previously. Construction of a center station (Elliott and Mercer 1 or 1A), however, would likely cause more disruption to traffic flow because travel lane closures would be more extensive and affect both travel directions.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Impacts Within a Block of the Alignment

Construction timing for both through Seattle Center alternatives (3.1 and 3.3) is a concern because of the many performance venues in the Center. Construction and utility relocation would need to be timed to minimize impacts on those activities. Street access may also be limited in certain areas during construction. Construction impacts for Queen Anne and Belltown would be similar to those for Seattle Center, although less potentially disruptive.

Impacts Within ¼ Mile of Stations

Construction impacts for the Queen Anne/Seattle Center/Belltown Segment station alternatives would be similar to those of other stations along the proposed Green Line including temporary disruption of traffic and business activity. Construction impacts would also include noise and traffic disruption associated with utility relocation and station construction. Construction of Seattle Center/Queen Anne 1 and 1A would result in the demolition of a portion of the Northwest Rooms northwest of Key Arena, with greater noise and dust impacts to an area of Seattle Center that has a high level of pedestrian activity.

Segment 4: Downtown/Pioneer Square Segment

Impacts Within a Block of the Alignment

Construction impacts would result in transportation and pedestrian disruption due to utility relocations; sidewalk, lane, and temporary street closures; and alignment construction activities similar to those described previously. Because of the density of utilities in downtown rights-of-way and City work period restrictions, utility relocations could take longer than in other areas and could have noise impacts to residential areas through the Downtown/Pioneer Square Segment.

Impacts Within ¼ Mile of Stations

Construction impacts for the Downtown/Pioneer Square Segment station alternatives would be similar to those of other stations along the proposed Green Line including temporary disruption of traffic and business activity.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Impacts Within a Block of the Alignment

Construction impacts would result in short-term traffic and pedestrian disruption due to utility relocations and alignment construction activities similar to those described previously.

Impacts Within ¼ Mile of Stations

Construction impacts for the SODO/Chinatown International District/Pioneer Square Segment station alternatives would be similar to those of other stations along the proposed Green Line including temporary disruption of traffic and business activity. Traffic and pedestrian disruption in the vicinity of the Weller Street station could be greater than other stations due to the density of use in the neighborhood. Residential uses in the south Pioneer Square area could experience temporary construction noise and dust.

Segment 6: West Seattle Segment

Impacts Within a Block of the Alignment

Construction in West Seattle would result in temporary disruption of vehicular and pedestrian traffic associated with relocation of utilities and placement of columns and beams. Construction of Alternative 6.1.2 to Pigeon Point, however, would result in clearing and grading on steep slopes and construction noise and dust. Construction of either bridge alternative is not expected to have significant adverse land or shoreline use impacts. Use of bridge construction barges would have to be coordinated with navigational use of the waterway.

Impacts Within ¼ Mile of Stations

Construction impacts for the West Seattle Segment station alternatives would be similar to those of other stations along the Green Line including temporary disruption of traffic and business activity due to on-street and off-street parking loss, detours, sidewalk closures, and congestion. Construction of Avalon station 2A would include clearing and grading of a site located on West Seattle Stadium Park. Users of the stadium could experience some construction noise and dust impacts.

Construction of Alaska Junction 2 could be more disruptive to businesses and pedestrians than construction of Alaska Junction 1 or 1A because of its more centralized location and higher traffic and

pedestrian volumes. Similarly, construction of Morgan Junction 2 station could be more disruptive than construction of Morgan Junction 1 or 1A because of its more central location in the Morgan Junction neighborhood business district.

4.17.5 Economics

4.17.5.1 Impacts

As noted above under general construction impacts and by area under Section 4.17.4, Land Use and Neighborhoods, construction activities would increase noise, dust, and congestion; decrease parking; and could interfere with pedestrian, automobile, and freight access to businesses, as well as the desirability for customers to visit the area if they have other choices. The duration of construction, as well as customers' perceptions of the inconvenience from construction would be the primary factors affecting the extent of the economic impact due to loss of business. However, in most areas the effect would likely remain localized within the station areas and along the guideway alignment. Streets where major portions of the guideway are located, such as 15th Avenue NW, Elliott Avenue W, California Avenue SW, Fifth Avenue, and Second Avenue, would have sequential sections under intermittent construction during the 2-year period. Transit service and on- and off-street parking spaces could be temporarily displaced. The locations where off-street parking would be permanently affected were discussed in Section 4.1, Transportation, and in Section 4.3, Land Use and Neighborhoods. While the long-term impacts due to this loss of parking could be mitigated by replacement parking, during construction other mitigations may be needed to provide temporary parking, transit shuttles, or other methods to maintain reasonably convenient parking and access to affected businesses.

Depending on the duration of the construction period, some loss of revenue and jobs at some businesses could be expected. Possible impacts are described in Section 4.17.2 and could include: disruption of transit routes or stops, impacts to truck access for deliveries, loss of on-street or off-street parking, increased congestion, and full to partial street and sidewalk closures or detours. Other areas with higher impacts would be station areas where the removal of on- and off-street parking could affect areawide supply or provide an inadequate supply for specific businesses, based on their typical demand.

4.17.5.2 Mitigation

In addition to the mitigation measures for construction impacts identified under other topic areas (Transportation, Land Use, Visual Quality and Aesthetic Resources, Noise and Vibration, and Air Quality) that could reduce the magnitude or duration of impacts, SMP will work with business groups, neighborhood associations, and directly with property owners to further minimize short-term construction-related impacts to businesses. SMP will develop a communication program to provide an opportunity for affected business owners to offer comments, concerns, and suggestions. An area-specific marketing or promotions program could also be developed to help maintain the visibility of businesses in affected areas and to inform customers of when major construction periods would be over, avoiding lingering perceptions of difficult access. The specific programs would vary by location, but could include initial communications and outreach, a project ombudsman, and ongoing coordination with construction management plans, focusing on such issues as:

- Seasonal business issues relative to construction staging
- Issues related to daily (24-hour) business cycles such as freight activities and peak-hour traffic
- Access changes
- Parking changes
- Transit changes

- Safety for patrons and workers
- Vibration, noise, and dust issues
- Special circumstances

Other mitigation measures could include shuttles, transit promotions, or other customer-oriented measures for affected areas. SMP could develop a mitigation plan for each construction segment that summarizes comments received and implementation strategies that address the comments. SMP could maintain a hotline for businesses during construction to provide ongoing coordination with affected businesses. Contacts would be recorded for public disclosure.

To minimize short-term construction-related impacts caused by lane, sidewalk, and road closures and subsequent detours, SMP would develop detour and temporary signage plans for staged work in cooperation with affected businesses. The plan should demonstrate improved visual or physical access to affected businesses where reasonable and feasible. (See Chapter 5 for more information).

4.17.6 Visual Quality and Aesthetic Resources

4.17.6.1 Impacts

Construction-related visual quality impacts would be common to all Green Line alternatives. During construction, the visual quality of the project area may be altered for both viewers of the road and viewers from the road. Construction-related signage and heavy equipment would be visible at and in the vicinity of construction sites. Mature vegetation, including trees, may be removed from some areas to accommodate construction of the guideway and stations, which would degrade or partially obstruct views or vistas. Short-term changes to the visual character of areas adjacent to the alignment could result from introduction of the following elements of construction:

- Construction vehicles and equipment
- Clearing and grading activities resulting in exposed soils until replanting or repaving occurs
- Erosion control devices such as silt fences, plastic ground cover, and straw bales
- Dust, exhaust, and airborne debris in areas of active construction
- Stockpiling of excavated material
- Staging areas used for equipment storage and construction materials
- Disruption to the Ship Canal navigation corridor

Impacts would be greatest at station locations, flyovers, and maintenance base sites.

Temporary lighting may be necessary for nighttime construction of certain project elements or in existing road or highway rights-of-way (to minimize disruption to daytime traffic). This temporary lighting could affect residential areas by exposing residents to glare from unshielded light sources, or by increasing ambient nighttime light levels.

4.17.6.2 Mitigation

Table 4.17-3 summarizes the construction-related visual quality impacts and suggested mitigation. Mitigation measures are also discussed in Chapter 5, Mitigation Program.

Temporary lighting impacts could be reduced by shielding light sources and by aiming and shielding to reduce spillover lighting in such areas. During construction and after construction, lighting should be directed away from traffic and residences and should be shielded to the maximum extent practicable to minimize spillover light while providing safety.

Table 4.17-3. Construction-Related Visual Quality Impacts and Suggested Mitigation

Construction-Related Impact	Potential Mitigation Measures
Visually obtrusive erosion control devices such as silt fences, plastic ground cover, and straw bales	Maintain erosion control structures and remove them as soon as the area is stabilized. Replace street trees and other vegetation with appropriately sized vegetation.
Reduced visibility resulting from dust, exhaust, and airborne debris in areas of active construction	Keep roadway as clean as possible by using street sweepers and wheel washes to minimize off-site tracking. During dry periods, apply water to exposed soils to minimize airborne sediment. Maintain construction equipment properly to minimize unnecessary exhaust.
Visually obtrusive stockpiling of excavated material and staging areas used for equipment storage and construction materials	Stockpile areas would be located in less visually sensitive areas and, wherever possible, not be visible from the road or to residents and businesses.

4.17.7 Air Quality

4.17.7.1 Impacts

Construction would comply with Puget Sound Clean Air Agency regulations (Regulation I, Section 9.15) requiring the use of reasonable precautions to minimize construction impacts from fugitive dust emissions. Refer to Section 4.12, Environmental Health, for more detail in the handling and disposal of hazardous materials.

Construction impacts could result from dust generated during site clearing, excavation, and construction and from temporary interruptions to traffic flow in the project area. Construction impacts would vary in extent and location, depending on the alternative selected and on weather conditions (rain suppresses dust, high wind speeds tend to entrain dust). It is possible that dust from construction sources could be contaminated with hazardous materials in some areas. Refer to Section 4.12, Environmental Health, for more detail on the handling and disposal of hazardous materials.

An estimate of the potential PM₁₀ emissions that would result from the combustion of diesel in construction vehicles associated with the project was made to quantify the magnitude of the potential diesel particulate emissions. The following assumptions were used in preparing the estimate:

- A representative group of construction equipment is two dump trucks, two loaders, and one drill crane operating concurrently with a combined rating of approximately 3,200 horsepower; equipment would operate 12 hours per day, seven days per week.
- The average equipment load would be 50 percent of capacity.
- The average equipment fuel use factor would be 0.068 gallons per horsepower-hour.

Based on this set of assumptions, annual diesel fuel use would be approximately 500,000 gallons per year, and associated PM₁₀ emissions would be approximately 10 tons per year. These emissions would not be localized on an annual basis because construction activity would move along the alignment over time. A stationary source of emissions with 10 tons per year of PM₁₀ emissions would not be considered a significant emissions source. Therefore, it is unlikely that diesel combustion emissions from Green Line construction would cause a significant air quality impact.

Direct and indirect air pollutant emissions of CO, VOC, and NO_x resulting from construction of the Ship Canal crossing (Ballard Bridge Crossing) and from structural retrofit construction on the West Seattle Bridge were each estimated and compared to the thresholds that would subject the Green Line to General Conformity regulations (40 CFR 93). These analyses were performed for these portions of the project because construction of a new bridge over the Ship Canal and structural improvements to the West Seattle Bridge will each require a permit issued by the U.S. Coast Guard. The General Conformity rule applies to these actions by the U.S. Coast Guard. In each case, an estimate of the maximum annual emissions from the construction was compared to the minimum thresholds that would subject the Coast Guard's action of issuing permits to the regulations. Based on the analyses, projected emissions from construction of the Ship Canal crossing and from structural retrofit of the West Seattle Bridge are each, and in total, below the established thresholds and no further analysis under the General Conformity regulations is required.

4.17.7.2 Mitigation

Mitigation measures normally used at construction sites include applying water or suppressants during dry weather and taking other measures, such as truck and equipment washing, to prevent the transport of dirt and dust from construction areas onto nearby roads. To reduce the effect of construction delays on traffic flow and resultant emissions, road or lane closures should be restricted to non-peak traffic periods when possible. To reduce emissions of PM₁₀ and diesel-related toxics, SMP is considering the use of low-sulfur fuels and/or other means to reduce construction emissions where possible. SMP is working with the Clean Air Agency to evaluate potential approaches. Please see Chapter 5, Mitigation Program.

4.17.8 Noise and Vibration

4.17.8.1 Noise Impacts and Mitigation

Impacts

Noise related to construction of the proposed project has the potential to cause noise impacts at residential and commercial uses near the active construction areas. The potential for impacts varies widely depending on the nature of the activity and equipment being used and the relative proximity of the sensitive use.

Construction noise is subject to specific limits in the Seattle noise ordinance, but the daytime construction noise limits are quite high (see Table 4.7-4 in Section 4.7, Noise and Vibration). Consequently, most daytime construction noise is able to comply with the noise limits without taking special precautions. However, in some instances, even daytime construction noise can be problematic at nearby receivers, and thus may require consideration of specific noise management techniques to prevent noise impacts.

Table 4.17-4 shows the typical range of noise levels for construction equipment that would be used during the construction of the Green Line. Sounds from construction equipment and activities (usually point sources) decrease about 6 dBA for each doubling in distance from the source. As shown in Table 4.17-4, construction equipment noise is relatively loud and could cause impacts at nearby residential or commercial receivers. Because portions of the construction activities could occur within 10 feet of some

existing uses, there is a relatively high potential for impacts, even though the sound levels are legally allowed under the Seattle noise ordinance.

Construction could cause noise impacts to nearby residential and commercial uses. Impacts would be most likely near areas of pile driving and where intensive construction lasts longer than a week or two or when construction occurs close to particularly noise-sensitive uses. While residences are usually most sensitive to noise from construction activities, other uses such as schools, veterinary and medical clinics, some performance venues, some offices, and other similar activities that are occupied during the day also may be sensitive to impacts from construction noise. So in addition to the residential uses along portions of the Green Line corridor, uses such as Ballard High School and some of the theaters at Seattle Center would have the potential to be adversely affected during construction of the Green Line.

Construction staging areas expected to be in use for more than a few weeks should be placed as far as possible from sensitive receivers, including residences. Likewise, in areas where construction would occur within about 200 feet of existing uses (such as residences, schools, and performing arts venues), effective noise control measures should be employed to minimize impacts. In addition to placing noise-producing equipment as far as possible from homes and businesses, such control could include using quiet equipment and temporary noise barriers to shield sensitive uses, and orienting the work areas to minimize noise transmission to sensitive off-site locations.

Table 4.17-4. Typical Noise Levels from Construction Activities and Equipment (dBA)

Activity	Range of Hourly Leqs		
	At 50 Feet	At 100 Feet	At 200 Feet
Clearing	83	77	71
Grading	75-88	69-82	63-76
Paving	72-88	66-82	60-76
Erection	72-84	66-78	60-72
Types of Equipment	Range of Noise Levels		
	At 50 Feet	At 100 Feet	At 200 Feet
Bulldozer	77-96	71-90	65-84
Dump Truck	82-94	76-88	70-82
Scraper	80-93	74-87	68-81
Paver	86-88	80-82	74-76
Generators	71-82	65-76	59-70
Compressors	74-81	68-75	62-69

Source: EPA (1971).

Some construction activities are likely to occur during nighttime hours when construction noise is subject to more stringent noise limits. While it would be premature to speculate about the specific locations and times when nighttime activities would be required, some of this work could necessitate variances from the Seattle noise limits. Nighttime construction work has the greatest potential to impact nearby residential uses, and should be carefully managed to minimize this potential.

Mitigation

It is expected that ultimately, construction noise related to the proposed project would require the development of a construction noise management plan designed to control and/or mitigate noise from the construction of the project. Such a plan would likely include specifications of “minimum safe distances”

from residential and commercial uses within which noise control measures would be required. Controls could include use of portable noise barriers around loud equipment, specifications about orientation, setbacks, and timing of loud operations, timing restrictions for idling equipment, and use of non-standard (e.g., strobe light and/or reduced volume) backup alarms. The plans for staging areas could include specification for ingress and egress routes to minimize the exposure of nearby sensitive use properties. The management plan might also include a complaint hotline for reporting noise issues and problems. Development of the construction noise management plan would occur after completion of the Final EIS.

Some aspects of how the construction noise management plan will work can be illustrated using specific examples that consider Ballard High School and the Seattle Center. In the instance of Ballard High School, a primary focus of the construction noise control plan would be the classrooms along the western side of the school building nearest the Green Line corridor. The noise management plan would consider the school as a noise-sensitive location, and would require proactive steps to minimize or prevent noise impacts to uses at the school. The noise plan could, for example, require any construction staging location or active construction area within 200 feet of the school to employ temporary noise barriers around fixed noise sources (e.g., generators or compressors) or excavation areas. For instance, properly placed noise barriers as simple as 3/4 inch plywood walls would provide large reductions in construction noise from such sources. In locations where noisy activities would be elevated too high above the ground for at-grade noise barriers to work, potentially disruptive construction activities might be limited to times when classrooms are not being used. In instances where this is not possible, discussions with school officials regarding the expected timing of potentially disruptive construction activities could allow coordination to minimize potential noise impacts at school activities.

At the Seattle Center, some activities at indoor and outdoor performance venues require quiet conditions that could be disrupted by uncontrolled construction noise at nearby locations. In this instance, noise control could include the same sorts of considerations described above (i.e., implementation of noise mitigation measures when work occurs within certain distances of a theater or outdoor venue), and also could include timing of construction to consider rehearsal and performance schedules when low-noise conditions are most important.

Due to the complexity of such a plan, the details of the construction noise management plan cannot be developed until a single alignment has been selected and at least partially so that specific construction operations can be delineated. At that time, all noise-sensitive locations along the Green Line corridor will be considered in relation to potential impacts from, and mitigation of construction noise. Mitigation measures and noise monitoring are discussed in Chapter 5, Mitigation Program.

4.17.8.2 Vibration Impacts and Mitigation

Impacts

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations with varying results, ranging from no perceptible effects at the lowest level, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest level.

Construction of the Green Line guideway and stations would require the use of heavy construction equipment, including excavators, loaders, graders, backhoes, and dump trucks. For the support column

foundations, crane-mounted drills for drilled shafts or pile drivers would be required. Table 4.17-5 summarizes typical vibration levels for different construction equipment types.

Table 4.17-5. Vibration Source Levels for Construction Equipment

Equipment Type	VdB Levels at 25 Feet Distance^{a,b}
Pile driver (impact)	112
Pile driver (vibratory)	104
Auger drills	87
Large bulldozer	87
Loaded trucks	86
Vibratory compactors	80
Jackhammer	79

^a Upper range of vibration impact.

^b RMS velocity levels in VdB re 1 micro inch/sec.

The vibration velocity levels of the construction equipment shown in Table 4.17-5 would increase on average by 6 VdB re 1 micro inch/sec if the distance between the source and receiver was reduced to five feet, depending on soil conditions.

Pile driving is potentially the greatest source of vibration associated with equipment used during construction of the Green Line. The vibration threshold is set at 100 VdB re 1 micro inch/sec for fragile buildings and 95 VdB re 1 micro inch/sec for extremely fragile historic buildings. Typically, structures (including sensitive or extremely sensitive historic buildings and area ways) within 50 feet of the vibration-causing activity would have a higher potential to be affected, structures within 50 to 100 feet would have a moderate potential, and structures more than 100 feet away would have a lower potential. Soil conditions and individual building characteristics are also factors that would be considered.

The use of vibratory pile drivers or an auger to install the piles instead of an impact pile driver would greatly reduce vibration levels. Hoerams could also be used in some areas. Driving piles into the ground with an impact pile-driving hammer powered by a combustion engine represents the highest vibration source levels during conventional construction, only exceeded by blasting. Depending on the weight of the hammer, the type of piles, subsoil conditions, and distance, pile driving can create a potential adverse vibration impact. Vibration source levels of impact pile drivers have been measured at a 25-foot distance and range between 112 and 104 VdB re 1 micro inch/sec. However, there are other approaches that would substantially reduce vibrations from driven piles. For example, vibratory pile drivers operate by continuously vibrating (shaking) the pile into the ground at one frequency. Vibration source levels of vibratory pile drivers at a 25-foot distance range between 105 and 93 VdB re 1 micro inch/sec, substantially lower than those of impact pile drivers. Vibratory pile drivers usually operate at high frequencies with high ground attenuation and minimal structural response of building structures. However, as continuous ground excitation at a fixed frequency may be more noticeable to nearby residents, vibration testing of the proposed vibratory equipment is recommended to ensure no impact to fragile historic buildings. Augered piles have the lowest vibration impact of all pile construction types, with vibration source levels at a 25-foot distance of 87 VdB re 1 micro inch/sec on the upper range. Compared to driven piles, drilled piles produce much lower vibration impact.

In most segments, the alternative alignments are within a relatively close distance to one another, and to the extent that significant historic buildings or structures are nearby, the potential for vibration impacts would be similar. The historic structures near the alternatives are identified in Section 4.14. Table 4.17-6

lists the historic buildings and characterizes the potential construction impact for each Green Line alignment alternative.

The most sensitive extremely fragile historic buildings are un-reinforced masonry, large concrete block, and load-bearing timber structures. Less sensitive fragile historic buildings are precast concrete, well-maintained wood, or steel.

In the Ballard Segment, two historic resources could experience vibration impacts; in the Interbay/Magnolia Segment, three resources could experience vibration impacts; and in the Queen Anne/Seattle Center/Belltown Segment, up to three historic properties could have potential vibration impacts. In the Downtown/Pioneer Square Segment, where a large number of historic properties are present, up to 56 historic or historic period archaeological resources could have potential for vibration impacts during construction. In the SODO/Chinatown International District/Pioneer Square Segment, two properties could have construction vibration impacts, and in the West Seattle Segment, up to four properties could be affected.

Experience has shown that vibration impact damage to buried segmented underground utilities is relatively rare; however, damage can occur depending on the pipe material, presence/absence of flexible joints, ground coupling, or pre-existing stresses. Utilities in the vicinity of the project are identified in Section 4.17.10, Public Services and Utilities.

Construction impacts from demolition of existing structures are not expected to exceed the vibration threshold for extremely fragile historic buildings. Vibration source levels from different types of demolition activities such as jack hammering or use of hoerams, large bulldozers, or heavy loaded trucks is below the 95 VdB re 1 micro inch/sec vibration limit.

Mitigation

Before construction begins, the structural integrity of historic properties' foundations and structures adjacent to planned construction work will be assessed. SMP will employ mitigation measures to prevent structural damage to historic structures. Potential mitigation measures could include: modifying the drilling or construction technique, installing recharge wells, and/or adding support to the adjacent structures.

SMP will minimize the impacts to these structures from any excavation activities through use of adequate shoring or other construction techniques to prevent settling impacts to historic structures.

Prior to construction, SMP will also inspect areaways and other historic resources listed on or eligible for the National Register of Historic Places, the Washington Heritage Register and Seattle City Landmarks and designated in the Final EIS as Fragile or Extremely Fragile by a team of professionals which could include as appropriate a vibration specialist, structural engineer, and architectural historian for an inventory of existing conditions. Where the survey finds it necessary based on building condition and final construction details, damage avoidance measures including shoring, bracing, or other appropriate measures will be implemented prior to construction.

Table 4.17-6. Historic Resources and Possible Construction Vibration Impact from Pile Driving

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
Ballard Segment					
B-114	Apartment Building 1505 NW 60 th Street	25 feet/Alternative 1.1/1.1(s)	Low	Sensitive	Low/moderate
		50 feet/Alternative 1.2	Low	Sensitive	Low/moderate
B-131	Mike's Chili Parlor 1447 NW Ballard Way	100 feet/Alternative 1.1.1	Low	Sensitive	Low/moderate
		385 feet/Alternative 1.1.1	Low	Sensitive	Low/moderate
		25 feet/Alternative 1.2	Low	Sensitive	Low/moderate
Interbay/Magnolia Segment					
I-74	Ace Tank 1123c Elliott Avenue W	50 feet/Alternative 2.1/2.1(s)	Moderate/High	Sensitive	Low/moderate
		25 feet/Alternative 2.2	Moderate/High	Sensitive	Low/moderate
I-80	Wilson Machine Works 1038 Elliott Avenue W	50 feet/Alternative 2.1/2.1(s)	Moderate/High	Very Sensitive	Moderate/high
		75 feet/Alternative 2.2	Moderate/High	Very Sensitive	Moderate/high
I-86	Phillips Scale Co. 934b Elliott Avenue W	50 feet/Alternative 2.1/2.1(s)	Moderate/High	Very Sensitive	Moderate/high
		75 feet/Alternative 2.2	Moderate/High	Very Sensitive	Moderate/high
Queen Anne/Seattle Center/Belltown Segment					
SC-7	Historic Building 7 Queen Anne Ave. N	25 feet/Alternative 3.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 3.2	Low	Sensitive	Low/moderate
		25 feet/Alternative 3.3	Low	Sensitive	Low/moderate
		25 feet/Alternative 3.5	Low	Sensitive	Low/moderate
SC-15	Center House 305 Harrison St.	15 feet/Alternative 3.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 3.3	Low	Sensitive	Low/moderate
SC-20	Auditorium Apartments 605 Fifth Ave. N	20 feet/Alternative 3.2	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
Downtown/Pioneer Square Segment					
D-5	Historic Building 2019 Fifth Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-7	Historic Building 420 Vine St.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-17	Historic Building 420 Blanchard St.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-18	Court Apartments 2132 Fifth Ave.	60 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-34	Time Square Building 414 Olive Way	15 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		15 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		15 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-40	Josephinum Hotel 1900 Second Ave.	40 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
D-50	Historic Building 211 Pine St.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-68	Exchange Building 821 First Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-69	Bank of California 815 Second Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-77	Carsen Boren Home 705 Second Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-78	Dexter Horton 710 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-81	Seattle's Best Coffee 619 Second Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-82	Alaska Building 618 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
D-86	Butler Garage 601 Second Ave.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-87	Historic Building 610 Second Ave	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-88	Hartford Building 600 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-92	Collins Building 520 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-94	Historic Building 512 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-95	Smith Tower 502 Second Ave.	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-99	Metropole Market 423 Second Ave. S	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
D-102	Historic Building 408 Second Ave. S	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-103	Historic Building 411 Second Ave. S	20 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-104	Historic Building 410 Second Ave. S	60 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-106	Historic Building 401 Second Ave. S	20 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-107	Historic Building 406 Second Ave. S	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-108	Historic Building 400 Second Ave. S	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-111	Historic Building 201 S Washington St.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
D-112	Union Gospel Mission 211 S Washington St.	60 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-113	Mathews and Chesnin Attorneys 219 S Washington St.	60 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		60 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-115	Historic Building 313 Second Ave. S	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-116	Historic Building 208 Second Ave. S	60 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		60 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-118	Comedy Underground 222 S Main St.	20 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-120	Historic Building 213 S Main St.	20 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		40 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		20 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-125	Leathers/Gourmet Sausages Co. 315 S Jackson St.	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		40 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
D-126	King Street Station 301 S Jackson St.	30 feet/Alternative 4.1	Low	Very Sensitive	Moderate/high
		30 feet/Alternative 4.2	Low	Very Sensitive	Moderate/high
		30 feet/Alternative 4.3	Low	Very Sensitive	Moderate/high
		30 feet/Alternative 4.4	Low	Very Sensitive	Moderate/high
D-128	Area Way 414 Olive Way Underneath Time Square Building	15 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		15 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		15 feet/Alternative 4.4	Low	Sensitive	Low/moderate
D-129	Area way 1516 2nd Ave Underneath Columbia Bldg.	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
407	Area Way Second and Cherry	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
406	Area Way Second and James	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
501	Area Way Second and Cherry	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
502	Area Way Second and Cherry	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
503	Area Way Second and James	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
601	Area Way Second and Yesler	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
701	Area Way Second and James	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
702	Area Way Second and Yesler	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1003	Area Way Second and Yesler	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1004	Area Way Second and Yesler	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1005	Area Way Second and Yesler	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
1002	Area Way Second and Washington	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1101	Area Way Second and Yesler	80 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1102	Area Way Second and Washington	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1103	Area Way Second and Washington	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
5001	Area Way Second and Washington	100 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		100 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		100 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		100 feet/Alternative 4.4	Low	Sensitive	Low/moderate
5003	Area Way Second and Main	80 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.4	Low	Sensitive	Low/moderate
1601	Area Way Second and Washington	80 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		80 feet/Alternative 4.4	Low	Sensitive	Low/moderate

Table 4.17-6. Historic Resources and Construction Vibration Impact from Pile Driving (continued)

Historic Building	Description/Address	Distance to Alignment	Potential for Pile Driving	Sensitivity ^{a,b}	Construction Vibration Impact
1602	Area Way Second and Washington	50 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		50 feet/Alternative 4.4	Low	Sensitive	Low/moderate
6001	Area Way Second and Main	10 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		10 feet/Alternative 4.4	Low	Sensitive	Low/moderate
6002	Area Way Second and S Jackson	20 feet/Alternative 4.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.2	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.3	Low	Sensitive	Low/moderate
		20 feet/Alternative 4.4	Low	Sensitive	Low/moderate
SODO/Chinatown International District/Pioneer Square Segment					
S-58	Markey Machinery Co. 79 S Horton Street	40 feet/Alternative 5.1	Moderate/High	Sensitive	Low/moderate
		60 feet/Alternative 5.2/5.2(s)	Moderate	Sensitive	Low/moderate
S-61	Rainier S Horton Street and Colorado	60 feet/Alternative 5.1	Moderate	Sensitive	Low/moderate
		40 feet/Alternative 5.2/5.2(s)	Moderate	Sensitive	Low/moderate
West Seattle Segment					
WS-82	Cherry Creek Furniture 4554 Alaska St.	40 feet/Alternative 6.2	Low	Very Sensitive	Moderate/high
WS-143	Farmers Insurance Group 5922 California Ave. SW	70 feet/Alternative 6.1	Low	Sensitive	Low/moderate
		40 feet/Alternative 6.2	Low	Sensitive	Low/moderate
WS-151	Residence 5948 California Ave. SW	70 feet/Alternative 6.1	Low	Sensitive	Low/moderate
		50 feet/Alternative 6.2	Low	Sensitive	Low/moderate
WS-154	Residence 5956-5958 California Ave. SW	40 feet/Alternative 6.1	Low	Sensitive	Low/moderate
		20 feet/Alternative 6.2	Low	Sensitive	Low/moderate
WS-188	Boysen Apartments 2906 SW Avalon Way	20 feet/Alternative 6.3(s)	Low	Very Sensitive	Moderate/high

^a Sensitive Fragile Historic Buildings - Distance Factor Calculated using the 100 VdB re 1 micro inch/sec Vibration Damage Threshold Criterion, as per FTA Guidelines.

^b Very Sensitive Extremely Fragile Historic Buildings - Distance Factor Calculated using the 95 VdB re 1 micro inch/sec Vibration Damage Threshold Criterion, as per FTA Guidelines.

Monitoring of Fragile and Extremely Fragile Structures: A vibration monitoring program would be implemented for all activities that could produce vibration levels meeting FTA Guidelines for extremely fragile historic buildings and extremely fragile historic buildings (100 VdB re 1 micro/inch/sec and 95 VdB re 1 micro inch/sec respectively) as described in Appendix NN to the Green Line EIS. Vibration monitoring would be undertaken when impact pile driving within specific distances of fragile and extremely fragile historic buildings. Depending on soil conditions, monitoring would occur when impact pile driving occurs within 150 feet of fragile historic structures and within 250 feet of extremely fragile historic structures, in consultation of SHPO. Vibration monitoring of sensitive and extremely sensitive historic buildings during any pile driving activity for Green Line construction would be similar to vibration monitoring that occurred during construction of Safeco Field, Seahawks Stadium, and the implosion of the Kingdome. Any damage to historic resources that is documented as a result of construction monitoring and caused by the construction of the Green Line would be repaired according to the technical guidance listed in the NPS Historic Preservation Briefs for specific rehabilitation issues.

If the results of monitoring indicate significant impacts to the monitored historic structure, work would be stopped and mitigating measures to present vibration impacts would be undertaken. Mitigation measures could be changed construction techniques (such as augured piles), soil augmentation, or support for the affected historic structure.

Monitoring and vibration mitigation will also be undertaken for utilities. Depending on the soil conditions, pipe material (with vitrified clay, concrete, PC, and cast iron all being sensitive), and proximity of the construction site to the location of utilities, a vibration monitoring program to measure vertical and lateral movement could be implemented when pile drivers or pavement braking equipment are used within 25 feet of existing underground utilities. The frequency, duration, and amplitude of the vibration levels would be recorded to verify that the vibration, velocity levels are below 0.5 inch per second in conjunction with visual inspections with officials from the utility company. If vibration levels exceed the threshold, work would stop and would not begin again until steps proposed to stabilize and/or prevent damage to the designated utilities were approved. Auger drilling could be considered if vibration levels from pile driving exceed the vibration threshold.

The level of vibration impact depends on the distance from sensitive buildings, but also on the soil conditions, ground coupling between the foundation and ground, and the natural frequency of the affected structure itself. These distance requirements have been calculated using very conservative assumptions for source levels, ground coupling, and building conditions. Very often, vibration levels in close proximity to pile driving are well below the vibration damage threshold criterion of 95 VdB re 1 micro inch/sec. If the use of pile driving is necessary near very sensitive buildings, additional soils information and vibration testimony could be gathered to establish the site-specific estimate for vibration levels. Driving equipment or approaches would be modified to reduce vibration, and SMP could monitor the vibration levels inside the building basement. In those cases where the measurements show interior vibration levels close to or in excess of the damage threshold, optional construction methods such as vibratory pile drivers or auger drills should be considered. Other mitigation such as temporary shoring and reinforcement of the building could be considered.

Other possible construction vibration mitigation measures could include the following:

- Conduct a structural inspection of sensitive historic buildings where vibration has the potential to cause impacts to establish a baseline for identification of construction vibration damage.
- Direct construction vehicles onto non-residential arterial streets.
- Operate earthmoving equipment on the construction site as far away from vibration-sensitive sites as possible.
- Select demolition and construction methods that do not create vibration impacts, wherever possible.

- Protect existing sensitive utility pipe materials or structures by exposing and reinforcing pipe joints or structures prior to vibration impact.
- Place a vibration shield around auger-type drilling equipment to isolate vibration from sensitive utilities or structures.
- Schedule vibration producing construction activities to avoid events in sensitive structures.
- To further isolate sensitive structures or utilities, excavate area adjacent to sensitive areaways, structures or utilities before foundation drilling or pile driving activity.

Chapter 5, Mitigation Program, summarizes mitigation measures to which SMP has committed to date.

4.17.9 Energy

4.17.9.1 Impacts

Table 4.17-7 indicates the amount of energy required to construct the Green Line. It includes the energy associated with general construction (stations, guideway, columns, Operations Center, power system, equipment, lighting, etc.), construction equipment maintenance, project labor commute, and Green Line vehicle manufacturing. Construction energy use is calculated using (1) project cost estimates from the Seattle Popular Monorail Plan (ETC 2002), (2) the SMP program schedule revised to reflect a Notice To Proceed for the Design Build Operate and Maintain contractor early in the second quarter of 2004, (3) a projected construction equipment schedule based on the adjusted program schedule, (4) industry standard equipment utilization rates, and (5) energy consumption rates multiplied by an average fuel (gasoline and diesel) cost of \$1.40 per gallon. Btu equivalents are calculated based on an average value of 131,850 Btu per gallon of gasoline/diesel. The Green Line is estimated to require $1,715.3 \times 10^9$ Btu of energy for construction, including an allowance for off-project support activities and for energy consumed by construction craft-labor vehicles commuting to and from the project site.

The No Action Alternative would consume no energy in association with Green Line construction. However, under the No Action Alternative there could be an increase in energy demand for road maintenance because of additional traffic on the roads and King County Metro bus system service increases associated with not constructing the Green Line.

Table 4.17-7. Green Line Construction Energy Use

Construction Activity	Energy Use ^a	Fuel ^b
General facilities construction	1,049.4	1.831
Construction equipment maintenance	241.4	7.959
Project labor commute	356.5	2.703
Monorail vehicle manufacturing	68.0	0.515
Total construction energy demand	1,715.3	13.0008

^a Values provided in 10^9 Btu.

^b Values provided in 10^6 Gallons combined gasoline and diesel.

Source: SMP (2003), Bechtel Jacobs (2003).

4.17.9.2 Mitigation

No mitigation is necessary.

4.17.10 Public Services and Utilities

4.17.10.1 Public Services Impacts and Mitigation

Impacts

Some traffic lanes may need to be temporarily closed for utility relocation and construction of Green Line columns and stations. These lane closures could affect emergency vehicles during construction of the Green Line. (See Section 4.17.2, Transportation, for more detail).

Mitigation

As part of the permitting process with the City of Seattle, SMP would provide the Seattle Department of Transportation with plans for street closures, detours, and other temporary street capacity restrictions. This would ensure that adequate service levels and access to public services are maintained during construction. The impact on response times for emergency response vehicles during construction could be partially mitigated through the use of intelligent traffic signal control technology installed prior to the start of construction. Delays could be further minimized by coordination with emergency service providers to identify the ongoing locations of restrictions, the identification of alternative routes, and provisions in construction traffic control plans and procedures to accommodate emergency vehicles.

The Seattle Police Department also provides officers for traffic control on construction sites, and the Seattle Traffic Control Manual for In-Street Work requires that uniformed officers be located at intersections where traffic signals are to be countermanded during construction (SDOT 1994). On-duty officers would assist the contractor's traffic flagging staff, ensure that construction site and surrounding traffic flows remain relatively constant, and provide coordination for emergency personnel responding to events in the proximity of the Green Line. Mitigation for collection of solid waste and recycling within the construction zones and detours would also be implemented. Please see Chapter 5, Mitigation Program, for more information.

4.17.10.2 Utilities Impacts and Mitigation

Typical Construction System Impacts

Potential construction (short-term) impacts to utilities are based on examination of available utility maps, discussions with utility representatives, data and literature review, and limited subsurface investigation. Exact locations and depths of utilities and impacts on them would be verified with utility providers during design stages and prior to construction of the Green Line. During the final design phase, construction methods and Best Management Practices (BMPs) would be developed by SMP and the design, build, operate, maintain contractor, in consultation with the utility purveyors, to provide spacing and protection measures specific to each site in order to avoid issues such as customer outages, lack of access, damage to facilities, settlement, vibration, dewatering groundwater, and hazardous materials. These measures would help establish protocols for relocating, replacing, protecting, and monitoring utilities during construction, and should minimize the potential for significant impacts. The potential impacts described in this section are very conservative. Where the alignment is located in the same general area as a utility, this EIS has assumed that the entire length of the utility would be relocated. In fact, design solutions could reduce or eliminate many utility relocation impacts.

Typically, water lines and high-pressure gas mains are located about three to six feet underground, and sewer pipes are located at least six feet below the surface. Smaller pipes, fiber-optic cables, telephone lines, and other utilities are often buried less than three feet deep. Water, sewer, and storm drain pipelines typically run parallel beneath streets, placed in various locations ranging from the center to the roadway periphery. Fiber-optic cables, telephone lines, underground electrical conduits, and smaller pipes are often located beneath sidewalks.

These utilities may or may not be affected during construction, depending on their depth below grade, material composition, the construction excavation limits, the exact location of the proposed guideways and columns, and other factors.

Utility pipes, conduits, cables, and other infrastructure in construction areas for monorail column foundations and station foundations would need to be relocated, protected, or otherwise avoided during construction. In general, most underground utilities crossed by the proposed route alignments that are located directly underneath elevated segment columns would be affected. However, elevated supports can often be placed to avoid conflicts with major utilities and can straddle crossed roadways, thereby avoiding utilities running beneath them. Utilities that would be crossed, and the approximate length of utility infrastructure that could be affected in areas where the routes parallel the utilities, are identified in Tables 4.17-8 and 4.17-9. All underground utility relocations share relatively common construction impacts, including pavement demolition, excavation, backfill, repaving, traffic control, and dust/noise monitoring. Utility relocations are discussed in the footnotes of Tables 4.17-8 and 4.17-9. Notable relocations are distinguished by their size, quantity, and/or their impact on services.

Underground utilities would typically be relocated in advance of the monorail guideway construction. City of Seattle standards would be used with approved designation on a case-by-case basis to determine which underground utilities would need to be relocated. Existing piping, conduits, and buried utilities that encroach on the areas required for foundations for the guideway would be removed and relocated, within the existing right-of-way, wherever feasible. Determination of acceptable new locations would be coordinated with the utility purveyor. Trenches would be excavated to provide for the new utilities. Under this instance, the existing pavement would be cut and removed, and soils would be excavated to a sufficient depth to place the new utilities. Trenches over four feet wide require shoring to ensure worker safety per Washington Industrial Safety and Health Act regulations and to prevent damage to adjacent utilities. In some cases, it could be necessary to remove concrete pavement in structural slab sections to relocate the underground utilities (SMP 2003b).

Existing underground utility service connections to adjacent residences or buildings on either side of the street would be extended or shortened by trenching and extending or truncating the utility service to the relocated mains, and will be in accordance with SPU's "Developer-Installed Water Mains, Information Sheets for Engineer." In some cases, it could be necessary to repair existing utilities and service lines that are crossed by the new utility mains, such as in areas where utilities are congested (SMP 2003b). No repairs to SPU waterlines are to be undertaken by the contractor, and the contractor is specifically prohibited to repair, alter, dismantle, modify or operate any SPU water facilities. (In the event of damage, the contractor is to call the 24-hour dispatch line at 206-386-1800). Overhead utilities such as power, trolley wires, and traffic lights could be temporarily moved during construction of the monorail guideway, particularly in the downtown retail area. Utilities that encroach on clearance requirements would be relocated elsewhere within the right-of-way. The relocation would be reviewed and approved by the utility purveyor to allow for access, maintenance, and the integrity of the utility (SMP 2003b). In some cases, access points, including manholes and vaults, may need to be relocated.

Disruptions to utility service during utility relocations would likely be minimal because temporary connections to customers would typically be established before relocating utility conveyances. However, inadvertent damage to underground utilities can occur during construction if utility locations are uncertain or misidentified. While such incidents do not occur frequently, they could temporarily affect service to customers served by the affected utility.

Construction activities may also affect access to service providers near construction areas by creating traffic detours, delays, and temporary displacement of parking or loading areas. As with any major construction

Table 4.17-8. Potential Impacts of Green Line Construction on Utilities

Segment and Alternative		Storm Drain Mains LF	Side Storm Sewers	Sewer and Combined Sewer Mains LF	Side Sewers	Water Mains LF ≥ 4" Diameter	Water Service	Fire Hydrants	Natural Gas LF 2" - 12" Diameter	Seattle Steam LF 8" - 22" Diameter
		8" - 30" Diameter	Each	8" - 30" Diameter	Each		Each	Each		
Ballard										
Alternative 1.1/1.1(s)	West Side of 15 th	1,900	13	110	0	0	0	0	100	0
Alternative 1.1.2	Far West Bridge	1,885	12	85	0	0	0	0	750	0
Alternative 1.2	Center of 15 th	0	0	5,210	192	5,325	137	17	750	0
Interbay										
Alternative 2.1/2.1(s)	West of 15th/Center of Elliott	700	0	3,885	162	0	0	0	970	0
	Dravus 1A, no alignment change	700	0	3,885	162	0	0	0	970	0
	Dravus 1B, alignment on W. of 15 th	700	0	3,885	162	0	0	0	970	0
Alternative 2.1.2	Far West Connection	535	0	3,885	162	0	0	0	970	0
Alternative 2.2	Center of 15th/West Side of Elliott	1,470	11	290	6	825	6	1	10025	0
Seattle Center										
Alternative 3.1	Seattle Center/Republican	0	0	2,240	62	0	0	0	265	0
Alternative 3.1.2	Seattle Center/Around EMP	0	0	2,240	62	0	0	0	265	0
Alternative 3.1.4	Revised Fifth Avenue	0	0	235	7	0	0	0	2200	0
Alternative 3.2	Mercer	0	0	165	0	1,260	13	1	475	0
Alternative 3.3	Thomas	0	0	2,680	3	0	0	0	1115	0
Alternative 3.5	Second/Denny	475	0	2,915	0	0	0	0	265	0
Downtown										
Alternative 4.1	West Side of Second	0	0	570	17	1,175	13	0	1925	140
Alternative 4.1.2	Route to Fifth & Stewart (Virginia)	0	0	995	12	1,175	13	0	2065	470
Alternative 4.2	East Side of Second	0	0	150	0	2,870 ⁷	39	5	320	740 ⁸
Alternative 4.3	Center of Second	0	0	399 ⁶	23	325	3	0	770	2060
Alternative 4.4	East Center of Second	0	0	150	0	325	3	0	320	740

Table 4.17-8. Potential Impacts of Green Line Construction on Utilities (continued)

Segment and Alternative		Storm Drain Mains LF	Side Storm Sewers	Sewer and Combined Sewer Mains LF	Side Sewers	Water Mains LF	Water Service	Fire Hydrants	Natural Gas LF	Seattle Steam LF
		8" - 30" Diameter	Each	8" - 30" Diameter	Each	≥ 4" Diameter	Each	Each	2" - 12" Diameter	8" - 22" Diameter
SODO										
Alternative 5.1	East of Third/Utah	820	0	280	0	1,395	10	6	1,785	0
Alternative 5.1.2	East Side of Third/Utah	0	0	280	0	1,345	14	6	1,820	0
Alternative 5.2	West Side of Third	120	0	1,420	22	1,260	4	4	2,580	0
West Seattle										
Alternative 6.1 ⁹	West Seattle I	0	0	5,334	205	7,390	220	19	555	0
Alternative 6.1A	Breakout of original Subsegment from Delridge to Yancy	0	0	1,374	49	7,790	220	19	555	0
Alternative 6.1.2	Past Pigeon Point	0	0	5,334	205	7,390	220	19	555	0
Alternative 6.1.4	SE Side of Fauntleroy	0	0	5,334	205	7,390	220	19	680	0
Alternative 6.1.6/6.1.6(s)	West Side of California	0	0	1,374	49	5,885	128	14	555	0
Alternative 6.2	West Seattle II	485	0	3,505	61	5,580	124	14	1,285	0
Alternative 6.2.2	Center of 35 th , North Side of Alaska, Avalon 2B	485	0	4,020	61	5,580	124	14	1,285	0
Alternative 6.3(s)	Delridge North Subsegment	0	0	339	12	7,910	224	20	555	0
Alternative 6.4/6.4(s)	Andover/Yancy Subsegment.	0	0	1,374	49	7,790	220	19	555	0
Alternative 6.5	Genesee Subsegment	0	0	1,374	49	7,790	220	19	555	0

Source: BERGER/ABAM (2003a–f). Underground Utility Drawings, Parts 1 and 2, dated 6/12/03 and 6/20/03, BERGER/ABAM Overhead Utility Relocation Tables, dated June 3, 2003, and SMP.

General Notes: The construction and length of services was not verified. Actual impacts to services, including "ripple" effects, will be determined in final foundation placement and alignment. Storm drains 8- to 30-inch diameter, sanitary and combined sewer mains 8- to 36-inch diameter, water mains > 4-inch diameter, natural gas 2- to 12-inch diameter, steam 8- to 22-inch diameter.

1 Side storm sewers obtained from review of BERGER/ABAM's 6/12/03 and 6/20/03 plans.

2 Side sewers assumed to be affected only when receiving sewer is relocated. Side sewer quantity reflects quantity of connections to relocated sanitary or combined sewer main only.

3 Water services assumed to be affected only when mains serving them are relocated. Water service quantity reflects connections to relocated main only.

4 Fire hydrants assumed to be affected only when mains serving them are relocated.

5 Alternatives 1.1, 1.1.2, 2.1, 2.1.2; many gas stubs along corridor; Alternative 2.1, 2" line on top 12" line; Alternative 2.2, 1,350 LF of 8" high-pressure gas line; Alternatives 3.1, 3.3, and 3.5; 30 LF of 2" in 6" casing; Alternative 3.3; 350 LF of 2" in 4" casing; Alternative 4.3; 370 LF of 2" in 6" casing; Alternative 4.3; 400 LF of 2" in 6" casing; Alternative 1.1.2; 6-8" line.

6 No relocation of metro sewer tunnel required in Alternative 4.3. However, 34 deep-shafted straddle foundations would be required and would require localized relocation of other utilities.

7 The total for Alternative 4.2 includes 2,190 linear feet (LF) of 20-inch water main along the east side of Second Avenue. Water service quantity from review of B/As 6/12/03 and 6/20/03.

8 Alternative 4.2; 330 LF of 8" in 21" casing.

9 Alternative 6.1.3 is identical to 6.1

Table 4.17-9. Potential Impacts of Green Line Construction on Electrical and Telephone Utilities

Segment and Alternative		Underground Power ¹⁰					Overhead Power ¹¹					Telephone		Fiber-Optic/ TV Cable		Metro Trolley Each
		LF	LF	LF	LF	LF										
		Duct Banks (Circuit Feet)	Primary ¹² Segments (Each)	Secondary ¹³ Segments (Each)	Impacted Facilities ¹⁴	Service s ¹⁵	Trans- mission (Each)	Distribution (Circuit Feet)	Supply (Circuit Feet)	Power Poles ¹⁶ (Each)	UG ¹⁷	OH ¹⁸	UG ¹⁷	OH ¹⁸		
Ballard																
Alternative 1.1/1.1(s)	West Side of 15th	0	0	0	19	281	0	4,465	4,005	143	0	6,020	0	3,325	0	
Alternative 1.1.2	Far West Bridge	0	0	0	19	281	0	5,135	5,130	143	0	6,715	0	3,675	0	
Alternative 1.2	Center of 15th	225	5	0	18	195	0	1,380	4,495	101	0	2,945	0	1,280	0	
Interbay																
Alternative 2.1/2.1(s)	West of 15th/Center of Elliott	1,190	0	0	12	127	0	9,025	3,465	116	0	7,730	0	1,425	0	
Alternative 2.1.2	Far West Bridge	1,190	0	0	12	127	0	8,890	3,465	116	0	7,930	0	1,165	0	
	Dravus 1A, no alignment change	1,190	0	0	12	127	0	9,025	3,465	116	0	7,730	0	1,425	0	
	Dravus 1B, alignment on W. of 15th	1,190	0	0	12	127	0	9,025	3,465	116	0	7,730	0	1,425	0	
Alternative 2.2	Center of 15th/West Side of Elliott	500	0	0	2	51	0	5,260	5,630	38	550	5,215	0	2,740	0	
Seattle Center																
Alternative 3.1	Seattle Center/Republican	495	0	0	3	46	0	2,200	340	17	0	2,595	0	2,125	4	
Alternative 3.1.2	Seattle Center/Around EMP	495	0	0	3	46	0	2,200	340	17	0	2,595	0	2,125	4	
Alternative 3.1.4	Revised Fifth Avenue	935	0	0	4	46	0	2,200	340	17	0	2,595	0	2,125	4	
Alternative 3.2	Mercer	3,030	0	0	8	3	0	545	1,025	8	85	1,255	0	395	4	
Alternative 3.3	Thomas	255	0	0	13	57	0	2,200	340	17	1,135	2,595	0	2,125	4	
Alternative 3.5	Second/Denny	255	0	0	10	49	0	2,200	340	17	0	2,595	0	2,125	4	
Downtown																
Alternative 4.1	West Side of Second	1,525	0 ¹⁹	23	20	*20	0	0	0	0	1,410	0	1,715	0	15	
Alternative 4.1.2	Route to 5th & Stewart (Virginia)	1,525	0 ¹⁹	23	20	*20	0	0	0	0	1,645	0	1,915	0	15	

Table 4.17-9. Potential Impacts of Green Line Construction on Electrical and Telephone Utilities (continued)

Segment and Alternative		Underground Power ¹⁰					Overhead Power ¹¹					Telephone		Fiber-Optic/ TV Cable		Metro Trolley Each
		LF	LF	LF	LF	LF										
		Duct Banks (Circuit Feet)	Primary ¹² Segments (Each)	Secondary ¹³ Segments (Each)	Impacted Facilities ¹⁴	Service s ¹⁵	UG ¹⁷	OH ¹⁸	UG ¹⁷	OH ¹⁸						
Alternative 4.2	East Side of Second	2,380	5	4	1	*20	0	0	0	0	2,470	0	2,085	0	17	
Alternative 4.3	Center of Second	305	0	0	0	*20	0	0	0	0	2230	0	7690	0	16	
Alternative 4.4	East Center of Second	305	5	4	1	*B	0	0	0	0	2470	0	2085	0	17	
SODO																
Alternative 5.1	East of Third/Utah	505	0	0	20	73	2	3,905	1,355	56	0	2,860	0	830	0	
Alternative 5.1.2	East Side of Third/Utah	275	0	0	16	33	2	3,865	3,045	64	0	2,790	0	2,995	0	
Alternative 5.2	West Side of Third	490	0	0	7	54	2	4,710	1,295	64	0	3,520	0	425	0	
West Seattle																
Alternative 6.1/(s)	West Seattle I	0	0	0	11	400	2	7,390	5,130	100	0	7,085	0	6,545	0	
Alternative 6.1A	Breakout of original Subsegment from Delridge to Yancy	0	0	0	13	410	2	7,500	5,220	108	0	7,085	0	6,545	0	
Alternative 6.1.2	Past Pigeon Point	0	0	0	11	400	2	8,055	5,130	100	0	7,210	0	6,545	0	
Alternative 6.1.4	SE Side of Fauntleroy	0	0	0	1	47	2	7,331	5,545	60	0	7,156	0	5,626	0	
Alternative 6.1.6/6.1.6(s)	West Side of California	0	0	0	5	123	2	6,500	6,100	52	0	7,085	0	6,545	0	
Alternative 6.2	West Seattle II	275	0	0	15	395	0	6,885	8,110	111	0	4,915	0	7,345	0	
Alternative 6.2.1	East side of 35 th (Avalon 2A)	275	0	0	4	15	0	6,885	5,525	93	0	4,915	0	7,345	0	
Alternative 6.2.2	Center of 35 th (Avalon 2B)	525	0	0	0	10	0	6,850	5,525	105	0	4,915	0	7,345	0	
Alternative 6.3(s)	Delridge North Subsegment	0	0	0	11	317	3	6,850	5,200	102	0	7,085	0	6,545	0	
Alternative 6.4/6.4(s)	Andover/Yancy Subseg.	0	0	0	14	400	2	7,120	5,200	93	0	7,085	0	6,545	0	

Table 4.17-9. Potential Impacts of Green Line Construction on Electrical and Telephone Utilities (continued)

Segment and Alternative		Underground Power ¹⁰					Overhead Power ¹¹					Telephone		Fiber-Optic/ TV Cable		Metro Trolley Each
		LF	LF	LF	LF							LF				
		Duct Banks (Circuit Feet)	Primary ¹² Segments (Each)	Secondary ¹³ Segments (Each)	Impacted Facilities ¹⁴	Service s ¹⁵	Trans- mission (Each)	Distribution (Circuit Feet)	Supply (Circuit Feet)	Power Poles ¹ ₆ (Each)	UG ¹⁷	OH ¹⁸	UG ¹⁷	OH ¹⁸		
Alternative 6.5	Genesee Subsegment	0	0	0	18	425	2	7,410	5,130	115	0	7,085	0	6,545	0	
	Delridge 4 (Genesee)	0	0	0	18	515	2	7,375	5,200	112	0	7,085	0	6,545	0	

Source: BERGER/ABAM (2003a–f). Underground Utility Drawings, Parts 1 and 2, dated 6/12/03 and 6/20/03, BERGER/ABAM Overhead Utility Relocation Tables, dated June 3, 2003, and SMP.

General Notes: The construction and length of services was not verified. Actual impacts to services, including “ripple” effects, will be determined in final foundation placement and alignment.

Notes continued from Previous Page

10. Underground Power information supplied by City Light July 2003 and January 2004.

11. Overhead Power information taken from Berger/ABAM 06/2003, Power Pole data supplied by City Light July 2003 and January 2004.

12. Segment is defined as the duct run between the facilities. Primary is the feeder contained in the affected segment.

13. The secondary cables contained in the affected segment.

14. Existing network vaults, manholes, or handholes.

15. Pole/pad transformer services only – does not include services associated with vault/handholes, which are considerable.

16. Also includes towers and steel transmission poles which have a higher cost/impact.

17. UG Underground

18. OH Overhead

19. Based on missing main duct bank entirely (SMP).

20. Serves downtown commercial and residential buildings, no exact count available (SMP).

project, guideway and station construction, regardless of the alternative, could cause increased localized congestion, traffic delays, and truck traffic. In addition, water lines and fire hydrants could need to be temporarily shut off in some locations for relocation, and access to standpipes on buildings could be obstructed, which could, if alternative supplies were not provided, affect utility services and fire fighting capabilities temporarily if alternative supplies were not provided. In some cases, establishing a parallel water main to avoid utility line crossing impacts may be considered.

Removing concrete pavement and installing foundations are anticipated activities with potential adverse vibration impacts to sensitive underground utilities, such as waterlines. The cast-iron, lead-joint water lines could require replacement or joint reinforcement before these construction activities commence. However, appropriate construction techniques, such as drilled shafts versus driven piles, would be implemented to minimize vibration impacts to sensitive utilities.

Alignment Alternative Impacts

The following sections provide an overview of potential construction impacts to utilities located in the six Green Line segments. The potential impacts are defined by type of utility service, and the notable and potentially significant impacts associated with specific route alternatives are further described above in Table 4.17-9. These potential impacts have been identified using a very conservative analysis that assumes utilities in the area of Green Line guideways would need to be relocated. In many cases, detailed design will reduce or eliminate the potential impact.

For the purposes of this section, for all segments except Downtown, overhead power lines are identified as the following:

- Transmission Lines – 34 to 240 kilovolt (kV) (usually three conductors)
- Distribution Lines – 4 to 26 kV (usually three conductors)
- Supply Lines – less than 1 kV (usually single conductors)

Unless otherwise noted, the majority of the overhead power lines affected simply cross the Green Line alignment, and would need to be raised, lowered, or switched to other existing poles (BERGER/ABAM).

Segment 1: Ballard Segment

Electrical Service

Alternative 1.1 or 1.1(s) - West Side of 15th

Underground: There are no impacts to underground power for this alternative.

Overhead: Approximately 8,500 feet of overhead electrical lines could require relocation with this alternative. Along 15th Avenue NW, at the location of the NW 65th Street station, one set of distribution lines would need to be relocated underground in two sections (total 300 feet), while one set of distribution lines and one supply line would require new poles (total 150 feet). Two other sections along this alternative would need to be relocated underground, one at 15th Avenue NW and NW 73rd (250 feet) and one at 15th Avenue NW and NW 75th (100 feet). New poles would need to be placed in six other areas along 15th Avenue NW, including NW 67th (500 feet), NW 70th (450 feet), NW 71st (350 feet), NW 73rd (500 feet), NW 77th (1,000 feet), and NW 76th (100 feet). No transmission lines would be affected with this alternative (BERGER/ABAM 2003b). City Light estimates the total number of new poles needed to cover this area at 143 (City

Light 2003c). Alternative 1.1.2 would impact an additional 1,800 feet of overhead distribution and supply line.

Alternative 1.2 - Center of 15th

Underground: This alternative would require relocation of approximately 250 feet of 18-inch underground electrical duct bank (ED) along 15th Avenue NW and five primary feeder segments.

Overhead: Approximately 5,900 feet of overhead electrical lines could require relocation with this alternative. Along 15th Avenue NW, at the location of the NW 67th Street station, one set of distribution lines would need to be relocated underground (250 feet). At NW 85th Street, the location of the Crown Hill 2 (Center) station, one set of distribution lines would again need to be relocated underground (250 feet). Another section at 15th Avenue NW and NW 73rd would also require the underground relocation of one set of distribution lines (150 feet). No transmission lines would be affected with this alternative (BERGER/ABAM 2003b). City Light data estimates a need for 101 new poles for this alternative (City Light 2003c).

Water Supply

Alternative 1.2 (Center of 15th) could require relocation of 5,300 feet of water main, 137 industrial service lines, and 17 fire hydrants, primarily along the center of 15th Avenue NW. There are no water main relocations proposed under Alternative 1.1/1.1(s) (West Side of 15th), or Alternative 1.1.2 (Far West Bridge) for this segment.

Sanitary Sewer and Storm Drains

Alternative 1.1/1.1(s) (West Side of 15th) could affect 100 feet of sewer main and 1,900 feet of storm drain, along with 13 side storm sewers. Notable impacts under this alternative would be the relocation of 550 feet of 15-inch, 300 feet of 21-inch, and a series (450 feet) of 18-inch storm drains along 15th Avenue NW. In combination, these potential relocations could result in moderate impacts to sewer and storm drains under this alternative. Alternative 1.1.2 (Far West Bridge) could require the relocation of 1,900 feet of storm drains, 100 feet of sewer main, and 12 side storm sewer connections. This alternative would have slightly lower, but similar, impacts to Alternative 1.1/1.1(s). Alternative 1.2 (Center of 15th) could require relocation of over 5,200 feet of sewer mains and 192 side sewers. Sewer main relocation under Alternative 1.2 would encompass smaller pipes (i.e., 10-inch and 12-inch) along 15th Avenue NW than those described for Alternatives 1.1/1.1(s) and 1.1.2; however, extensive side sewer displacements could result.

Natural Gas

Alternatives 1.1 or 1.1(s) (West Side of 15th) could require relocation of 100 feet of natural gas line. Alternatives 1.1.2 (Far West Bridge) and 1.2 (Center of 15th) could increase the impact to 750 feet each. All Ballard alternatives would affect multiple gas stubs along the corridor along 15th Avenue NW. Considerable displacements to the multiple users on the system during construction could occur under Alternatives 1.2 and 1.1.2.

Telecommunications, Fiber-Optic, and Trolley Lines

Alternatives 1.1 or 1.1(s) (West Side of 15th) could require relocation of over 6,000 feet of overhead telephone lines and over 3,300 feet of overhead fiber-optic or television (FO/TV) cable. Alternative 1.1.2 (Far West Bridge) could increase overhead telephone impact to over 6,700 feet and overhead FO/TV impact to nearly 3,700 feet. Alternative 1.2 (Center of 15th) would have the lowest potential impact to

overhead utilities, requiring relocation of approximately 2,950 feet of telephone line and 1,300 feet of FO/TV lines. No trolley lines would be affected by these alternatives in the Ballard Segment.

Within this segment, some overhead utilities could be relocated underground, resulting in potential secondary impacts to roads, sidewalks, and adjacent businesses or services. Portions of overhead utility lines could require underground relocation in approximately four locations each for Alternatives 1.1, 1.1.2, and 1.2 (BERGER/ABAM 2003b).

Preferred Alternative (Summary of Impacts)

Alternatives 1.1(s) (West Side of 15th single beam) and 1.1.1 (West Bridge)

Utility relocation impacts for this segment of the Preferred Alternative include 8,500 feet of overhead power lines; 6,000 feet of overhead telephone lines; 3,300 feet of overhead FO/TV cable. These impacts to overhead lines are slightly higher than those for Alternative 1.2, however, no underground power, telephone or FO/TV lines will be affected for this alternative. Other impacts for the Preferred Alternative in this segment include 1,900 feet of storm drains; 100 feet of sewer mains; and 100 feet of natural gas lines. The impacts to water and sewer mains are substantially less than those for Alternative 1.2.

Segment 2: Interbay/Magnolia Segment

Electrical Service

Alternative 2.1 or 2.1(s) - West of 15th/Center of Elliott

Underground: This alternative would require relocation of 200 feet of 12-inch ED and 1,000 feet of ED (22- by 28-inch) along 15th Avenue W.

Overhead: Approximately 12,500 feet of overhead electrical lines could require relocation with this alternative. At Sixth Avenue W and Mercer Street, the Elliott Avenue W station could require the underground relocation of two sets of overhead distribution lines (450 feet). An additional 300 feet of distribution lines would be relocated underground further along Elliott Avenue W at W Mercer Street and W Mercer Place. Between Garfield and W Barrett along 15th Avenue W, over 5,000 feet of distribution lines would require relocation underground. Along 16th Avenue W at W Dravus/Bertona and the W Dravus Street station, another 1,050 feet of distribution line would need to be relocated underground or to 17th Avenue W. No transmission lines would be affected by this alternative (BERGER/ABAM 2003b). City Light estimates a need for 116 new poles for this alternative (City Light 2003c). Impacts for Dravus 1B would be similar to those for Alternative 2.1.

Alternative 2.2 - Center of 15th/West Side of Elliott

Underground: This alternative would require the relocation of two 12-inch EDs (250 feet each) along Elliott Avenue.

Overhead: Approximately 10,900 feet of overhead electrical lines could require relocation with this alternative. Along Elliott Avenue W, over 3,400 feet of overhead electrical distribution line would require relocation underground, and another 850 feet of distribution line along 15th Avenue W would also require relocation underground. A minimal amount of supply line (approximately 350 feet) would require underground relocation under this alternative. No transmission lines would be affected by this alternative (BERGER/ABAM 2003b). City Light estimates a need for 38 new poles for this alternative (City Light 2003c).

Water Supply

Alternative 2.2 (Center of 15th/West Side of Elliott) could require the relocation of 850 feet of water main and six industrial service lines along 15th Avenue NW and Elliott Avenue. Alternatives 2.1/2.1(s) (West Side of 15th/Center of Elliott), 2.1.2 (Far West Bridge), Dravus 1B (Barrett) and Dravus 2 would not require relocations to water mains in this segment.

Sanitary Sewer and Storm Drains

Alternative 2.1/2.1(s) (West Side of 15th/Center of Elliott), Dravus 1A and Dravus 1B could displace 3,900 feet of sewer main, 700 feet of storm drains, and 162 side sewers along 15th Avenue NW. Alternative 2.1.2 (Far West Bridge) would have slightly lower impacts to storm drains, requiring 550 feet of relocation, but equivalent impacts to sewers. Therefore, considerable displacements to multiple users on the system could occur on a short-term basis during construction under Alternatives 2.1/2.1(s) and 2.1.2. Alternative 2.2 (Center of 15th/West Side of Elliott) is expected to have the lowest comparable impact to sewer and storm drains, with relocations estimated at 300 feet of sewer main and over 17 side and storm sewers. Alternative 2.2 would have the greatest potential impacts to storm drains, with relocations estimated at 1,500 feet. Notable impacts for this alternative include the relocation of 400 feet of 18-inch, 300 feet of 24-inch, 400 feet of 15-inch, and 300 feet of 30-inch storm drains in the vicinity of Elliott Avenue W and 15th Avenue W (BERGER/ABAM 2003a).

Natural Gas

Alternatives 2.1/2.1(s) (West Side of 15th/Center of Elliott) and 2.1.2 (Far West Bridge) could require relocating 1,000 feet of natural gas lines. Alternative 2.2 (Center of 15th/West Side of Elliott) could have the greatest potential impact, as it could displace over 10,000 feet of natural gas lines. The principal impacts for this alternative include relocation of 1,250 feet of 8-inch high pressure (Elliott Avenue), 3,300 feet of 12-inch line (Elliott Avenue), and 5,100 feet of 12-inch line (15th Avenue W). This relocation could be costly and could result in secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocation, and potential relocation of other localized utilities.

Telecommunications, Fiber-Optic, and Trolley Lines

Alternative 2.1/2.1(s) (West Side of 15th/Center of Elliott), and Dravus 1B could require the relocation of over 7,700 feet of overhead phone lines and over 1,400 feet of overhead FO/TV lines. Alternative 2.1.2 (Far West Bridge) could have a slightly higher impact to overhead telephone lines, but a slightly lower impact to overhead FO/TV cable. Alternative 2.2 (Center of 15th/West Side of Elliott) could affect over 5,200 feet of overhead phone lines and 550 feet of underground phone lines, as well as more than 2,700 feet of overhead FO/TV lines.

Within this segment, some overhead utilities could be relocated underground, resulting in potential secondary impacts to roads, sidewalks, and adjacent businesses or services. Portions of overhead utility lines could require underground relocation in approximately 18 locations for Alternative 2.1/2.1(s) or 2.1.2 and 17 locations for Alternative 2.2 (BERGER/ABAM 2003b).

Preferred Alternative (Impact Summary)

Alternatives 2.1 (West Side of 15th/Center of Elliott)

Utility relocation impacts for this segment of the preferred alignment include 1,200 feet of underground electrical duct banks and 12,500 feet of overhead electrical lines; 7,700 feet of telephone lines; 1,400 feet of FO/TV cable. Impacts to both overhead and underground power lines would be slightly higher for this

alternative than for Alternative 2.2. Impacts to telephone and FO/TV would also be higher for this alternative; however, no underground telephone would be impacted. Other impacts include 700 feet of storm drains; 3,900 feet of sewer mains; and 970 feet of natural gas lines. Impacts to storm drains, water mains, and natural gas lines for this alternative would be substantially lower than those for Alternative 2.2, however, impacts to sewer mains would be substantially higher for the Preferred Alternative.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Electrical Service

Alternative 3.1 - Seattle Center/Republican

Underground: This alternative would require the relocation of 250 feet of a 6-inch ED along Harrison Street, 200 feet of a 92-inch ED along Republican Street, and 50 feet of ED of unknown size along W Harrison Street. Alternative 3.1.4 would impact an additional 400 feet of duct bank.

Overhead: Approximately 2,550 feet of overhead electrical lines could require relocation with this alternative. One set of distribution lines (approximately 1750 feet) would require underground relocation along W Harrison Street at the location of the Seattle Center/Queen Anne 1 (North) station. No transmission lines would be affected by this alternative (BERGER/ABAM 2003b). City Light estimates a need for 17 new poles for this alternative (City Light 2003c). Alternative 3.1.2 impacts would be similar to Alternative 3.1.

Alternative 3.2 - Mercer

Underground: This alternative could require the relocation of 400 feet of a 12-inch ED along Elliott Avenue, 100 feet of a 4-inch ED along W Harrison Street, 550 feet of an 18-inch ED along Fifth Avenue N, and an additional 1,250 feet of 18-inch ED further along Fifth Avenue N. The relocation of two 2-inch electrical pipes along Fifth Avenue N could also be required (450 feet each). Alternative 3.2 would impact only 340 feet of ED.

Overhead: Approximately 1,600 feet of overhead electrical lines could require relocation with this alternative. One set of distribution lines (approximately 250 feet) would require underground relocation along W Harrison Street in the vicinity of First Avenue N, Queen Anne Avenue, and First Avenue W. One supply line (approximately 250 feet) could be relocated underground along W Harrison Street at Fourth Avenue W. No transmission lines would be affected by this alternative (BERGER/ABAM 2003b). City Light estimates a need for eight new poles for this alternative (City Light 2003c).

Alternative 3.3 - Thomas

Underground: This alternative could require the relocation of 250 feet of 6-inch ED along Harrison Street.

Overhead: Approximately 2,550 feet of overhead electrical lines could require relocation with this alternative. One set of distribution lines (approximately 1,750 feet) could require underground relocation along W Harrison Street in the vicinity of First Avenue N, Queen Anne Avenue, and First Avenue W. No transmission lines would be affected by this alternative (BERGER/ABAM 2003b). City Light estimates a need for 17 new poles for this alternative (City Light 2003c).

Alternative 3.5 - Second/Denny

Impacts to both underground and overhead electrical facilities for this alternative would be comparatively similar to those of Alternative 3.3.

Water Supply

Alternative 3.2 (Mercer) could require relocation of 1,300 feet of water main and 13 industrial service lines along Elliott Avenue W, W Harrison Street, and Fifth Avenue N. There are no water main relocations proposed for any of the other alternatives for this segment.

Sanitary Sewer and Storm Drains

Alternatives 3.1 (Seattle Center/Republican) and 3.1.2 (Around EMP) could require the relocation of 2,250 feet of sewer main and 62 side sewers, resulting in the greatest potential impacts to side sewers and moderate impacts to sewer main. Notable impacts under these alternatives could include the relocation of 600 feet of 12-inch, 250 feet of 15-inch, 1,400 feet of 18-inch, and 350 feet of 21-inch sewer main along Fifth Avenue (BERGER/ABAM 2003a). Alternative 3.2 (Mercer) could have the lowest comparable impacts, with the estimated relocation of 200 feet of sewer main and no relocations to side sewers. Alternative 3.3 (Thomas) could relocate 2,700 feet of sewer main and three side sewers, resulting in slightly higher impacts to sewer main and substantially lower impacts to side sewers than Alternatives 3.1 and 3.1.2. Alternative 3.5 (Second/Denny) could have the greatest potential impacts to sewer main and storm drains and no impacts to side sewers, with relocations estimated at 2,900 feet and 500 feet, respectively. The potential relocations under Alternatives 3.1, 3.1.2, 3.3, and 3.5 could be costly and could result in secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocation, and potential relocation of other localized utilities.

Natural Gas

Alternatives 3.1 (Seattle Center/Republican), 3.1.2 (Around EMP), and 3.5 (Second/Denny) could require the relocation of 300 feet of natural gas lines. Alternative 3.1.4 (Revised Fifth Avenue) could impact 2,100 feet of gas lines. Alternative 3.2 (Mercer) could relocate 500 feet of line. Alternative 3.3 (Thomas) could require the relocation of more than 1,100 feet of line in the vicinity of Thomas Street and W Harrison Street. Alternative 3.2 would have the greatest impact to natural gas, requiring the relocation of approximately 2,700 feet of pipe.

Telecommunications, Fiber Optics, and Trolley Lines

Alternatives 3.1 (Seattle Center/Republican), 3.1.2 (Around EMP), 3.1.4 (Revised Fifth Avenue) 3.3 (Thomas), and 3.5 (Second/Denny) could require the relocation of nearly 2,600 feet of overhead phone lines, more than 2,100 feet of overhead FO/TV lines, and four sets of metro trolley lines. Alternative 3.3 could also affect over 1,100 feet of underground telephone line. Alternatives 3.2 (Mercer) could affect over 1,200 feet of overhead phone lines and 85 feet of underground phone lines, as well as nearly 400 feet of overhead FO/TV lines and four sets of metro trolley lines. Alternative 3.3 would have the greatest potential impacts, as it could require both overhead and underground relocations over several blocks in the vicinity of W Harrison Street, Queen Anne Avenue N, and Elliott Avenue W, resulting in considerable costs and potential disruptions to service. In addition, secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocation, and potential relocation of other localized utilities, may result.

Within this segment, some overhead utilities could be relocated underground, resulting in potential secondary impacts to roads, sidewalks, and adjacent businesses or services. Portions of overhead utility lines could require underground relocation in approximately three locations for Alternatives 3.1, 3.1.2, and 3.3 and five locations for Alternative 3.2 (BERGER/ABAM 2003b).

Preferred Alternative (Impact Summary)

Alternative 3.1 (Seattle Center/Republican) from W Harrison Street through Seattle Center and the EMP to Fifth Avenue N with Alternative 3.1.4 over the center of Fifth Avenue N; and Alternative 3.2 from Fifth Avenue to Stewart Street through Belltown.

This alternative would affect approximately 500 feet of underground electrical duct bank along W Harrison and Republican Streets and 1,750 feet of overhead distribution lines along W Harrison Street. Following the Alternative 3.1 alignment through the Seattle Center avoids the major impact to water mains along Mercer Street. Conversely, impacts to sewer have been substantially reduced by switching to the Alternative 3.1.4 alignment over Fifth Avenue N and the Alternative 3.2 alignment on the west side of Fifth Avenue. In addition, the west side Fifth Avenue alignment reduces the impact to FO/and TV cable.

Segment 4: Downtown/Pioneer Square Segment

Electrical Service

Based on subsurface investigation of the main combined electrical power and telephone duct bank on Second Avenue, SMP engineers have refined information on impacts to underground electrical facilities reported in the Draft EIS. Updated data, assuming far fewer impacts is, provided for the Final EIS.

Alternative 4.1 - West Side of Second

Underground: This alternative would require the relocation of 800 LF of ductbank greater than 18 inches wide, and 700 LF of conduit 6 inches or less.

Alternative 4.2 - East Side of Second with Crossover

Underground: This alternative would require the relocation of 1,500 LF of duct bank greater than 18 inches wide, and 900 LF of conduit 6 inches or less.

Alternative 4.3 - Center of Second

Underground: This alternative would require the relocation of 300 LF of duct bank greater than 18 inches wide.

Alternative 4.4 – East of Center with Crossover

Underground: Similar to Alternative 4.3.

Water Supply

Alternatives 4.1 (West Side of Second) and 4.1.2 (Route to Fifth and Stewart [Virginia]) could require relocation of 1,200 feet of water main. Alternative 4.2 (East Side of Second with Crossover) could require relocation of 2,900 feet of water main along Second Avenue. Alternatives 4.3 (Center of Second) and 4.4 (East Center of Second) would require 350 feet of water main. Alternative 4.2 would have the greatest potential impact, including the relocation of 2,200 feet of 20-inch water main along the east side

of Second Avenue. This is a major line in the Downtown area, and relocation of this service could be costly and result in potential temporary disruptions to service in this high-density retail and business district in order to establish a parallel line. In addition, secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocation and potential relocation of other localized utilities would likely occur.

Sanitary Sewer and Storm Drains

Alternative 4.1 (West Side of Second) could require the relocation of 600 feet of sewer mains and 17 side sewers. Alternative 4.1.2 (Route to Fifth and Stewart [Virginia]) would have the greatest potential impact, requiring relocation of 1,000 feet of sewer main and 12 side sewers. Alternatives 4.2 (East Side of Second) and 4.4 (East Center of Second) with Crossover would have minimal impacts, requiring relocation of only 150 feet of sewer main and no side sewers.

Alternative 4.3 (Center of Second) could require relocation of 23 side sewers and would run directly above a 102-inch Metro combined sewer tunnel known as the Elliott Bay Interceptor. A smaller 20-inch sewer line also runs directly above the 102-inch tunnel. Because of its size, it would not be practical to relocate all or a portion of the Elliott Bay Interceptor. While it is possible to construct the Green Line Alternative 4.3 above this sewer line, special deep-shafted columns with below-grade straddle foundations would be required to avoid direct impacts to the line. (Stations for this alignment alternative would be supported with aboveground straddle bent structures that would span Second Avenue.) Metro staff has indicated that maintenance access to the Elliott Bay Interceptor could occur without disrupting service or facilities on the Green Line, as the sewer is constructed in a tunnel-like configuration allowing horizontal access. Use of the below-grade straddle columns for this alternative would compromise two lanes of traffic on Second Avenue, rather than one. This potential impact would result in greater traffic impacts than other alternatives. Due to the presence of the sewer tunnel and possible construction constraints, Alternative 4.3 could have greater sewer and stormwater impacts than either Alternative 4.1, 4.2, or 4.4 along Second Avenue.

Natural Gas

Alternative 4.1 (West Side of Second) could require relocation of 1,950 feet of natural gas line. Alternative 4.1.2 (Route to Fifth and Stewart [Virginia]) is expected to result in the greatest impacts to natural gas, requiring the potential relocation of 2,050 feet of line in the vicinity of Stewart Avenue and Second Avenue. Alternatives 4.2 (East Side of Second with Crossover) and 4.4 (East Center of Second) could have the least impacts, requiring the relocation of 350 feet of natural gas line, while Alternative 4.3 (Center of Second) could require the relocation of 800 feet of natural gas line.

Steam

Alternative 4.1 (West Side of Second) could have the least impact to steam, requiring the relocation of 150 feet of pipe. Alternative 4.1.2 (Route to Fifth and Stewart [Virginia]) could require the relocation of 500 feet of pipe, while Alternatives 4.2 (East Side of Second with Crossover) and 4.4 (East Center of Second) could require the relocation of 750 feet of pipe. Alternative 4.3 (Center of Second) would result in the greatest impact to steam, requiring relocation of 2,050 feet of pipe. Notable impacts under this alternative include the relocation of 550 feet of 18-inch, 600 feet of 12-inch, 350 feet of 8-inch (in 21-inch casing), and 400 feet of 8-inch steam pipe in the vicinity of Second Avenue and Stewart Avenue (BERGER/ABAM 2003a). Alternative 4.3 could be quite costly and could result in secondary impacts associated with replacement of the roadway following utility relocation and potential relocation of other localized utilities.

Telecommunications, Fiber Optics, and Trolley Lines

Alternative 4.1 (West Side of Second) could require the relocation of 1,400 feet of underground phone lines, 1,700 feet of underground FO/TV lines, and 15 sets of Metro trolley lines. Alternative 4.1.2 (Route to Fifth and Stewart [Virginia]) could require the relocation of 1,600 feet of underground phone lines, 1,900 feet of underground FO/TV lines, and 15 sets of Metro trolley lines. Alternatives 4.2 (East Side of Second with Crossover) and 4.4 (East Center of Second) could require the relocation of 2,500 feet of underground phone lines, 2,100 feet of underground FO/TV lines, and 17 Metro trolley lines. Alternative 4.3 (Center of Second) could require 2,250 feet of underground phone lines, 7,700 feet of underground FO/TV lines, and 16 Metro trolley lines.

Alternatives 4.2 and 4.4 would have the greatest impact to Metro trolley lines along Second Avenue, Stewart Street, Third Avenue S, and Fifth Avenue. No overhead telecommunications lines would be affected in the Downtown Segment.

Preferred Alternative (Impact Summary)

Alternatives 4.1 (West Side of Second) and 4.1.2 (Route to Fifth & Stewart – Virginia)

This alternative could require relocation of 1,600 feet of underground telephone and 1,900 feet of underground FO/TV cable, less than the other alternatives. This alternative will avoid the main electrical and telephone duct banks, and the 102-inch Metro combined sewer tunnel along Second Avenue, preventing ripple effects to other utilities. Other impacts include the potential relocation of 1,200 feet of water main, 1,000 feet of sewer main and 12 side sewers, 2,050 feet of natural gas line, 500 feet of steam pipe, and 15 sets of Metro trolley lines.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Electrical Service

Alternative 5.1 - East Side of Third/Utah

Underground: This alternative could require the relocation of 200 feet of a 12-inch ED along S Horton Street. It could also require the relocation of 100 feet of 7-inch ED and 200 feet of 8-inch ED along Third Avenue. Alternative 5.1.2 (East Side of Third/Utah) would impact less than 300 feet of ED.

Overhead: Approximately 5,250 feet of overhead electrical lines could require relocation with this alternative. One set of distribution lines (approximately 800 feet) could require underground relocation along S Horton Street in the vicinity of Colorado Avenue and Utah Avenue S. At Utah Avenue S and S Hanford Street, another 100-foot section of distribution lines could require underground relocation. At Utah Avenue S and S Lander, two more sets of distribution lines, a total of 500 feet, would be relocated underground. The Lander station at First Avenue S could require the underground relocation of 250 feet of line, including one set of distribution lines and one supply line. Along Third Avenue S at S Holgate Street, four sets of distribution lines, totaling over 1,100 feet, would be relocated underground. The Safeco Field station at S Atlantic Street would require the relocation of two additional sets of distribution lines (600 feet). This alternative also crosses transmission lines at Utah Avenue S and S Hanford Street, and again at Third Avenue S and S Holgate Street. The proposed approach to crossing these transmission lines is to raise the transmission lines, running the guideway below them (BERGER/ABAM 2003b). City Light estimates a need for 56 new poles for this alternative (City Light 2003c).

Alternative 5.1.2 would impact an additional 1,500 feet of overhead distribution and supply lines compared to Alternative 5.1, and a total of 64 power poles.

Alternative 5.2 or 5.2(s) - West Side of Third/Utah

Underground: This alternative could require the relocation of 100 feet of 8-inch ED and 400 feet of 18-inch ED along Third Avenue.

Overhead: Approximately 6,000 feet of overhead electrical lines could require relocation with this alternative. One set of distribution lines (approximately 800 feet) could require underground relocation along S Horton Street in the vicinity of Colorado Avenue and Utah Avenue S. At Utah Avenue S and S Hanford Street, another 100-foot section of distribution lines could require underground relocation. At Utah Avenue S and S Lander, two more sets of distribution lines, a total of 600 feet, would be relocated underground. The Lander station at First Avenue S could require the underground relocation of 500 feet of line, including one set of distribution lines and one supply line. Along Third Avenue S at S Holgate Street, five sets of distribution lines, totaling over 2,050 feet, would be relocated underground. The Safeco Field station at S Atlantic Street would require the relocation of two additional sets of distribution lines (700 feet). This alternative also crosses transmission lines at Utah Avenue S and S Hanford Street, and again at Third Avenue S and S Holgate Street. The proposed approach to crossing these transmission lines is to raise the transmission lines, running the guideway below them (BERGER/ABAM 2003b). City Light estimates a need for 64 new poles for this alternative (City Light 2003c).

Water Supply

Alternatives 5.1 (East Side of Third/Utah) and 5.1.2 (First Avenue S) could result in the greatest potential impacts, based on displacements to multiple users from the relocation of 1,350 to 1,400 feet of water main and 10 to 14 service connections. Alternative 5.2/5.2(s) (West Side of Third/Utah) could result in proportionately lower impacts, requiring relocation of 1,300 feet of water main and four service connections.

Sanitary Sewer and Storm Drains

Alternative 5.1 (East Side of Third/Utah) could require the relocation of 300 feet of combined sewer and 800 feet of storm drain main lines. Alternative 5.1.2 (First Avenue S) could also require the relocation of 300 feet of combined sewer, but would result in no impacts to storm drains. Alternative 5.2/5.2(s) (West Side of Third/Utah) could have the greatest potential impact, requiring relocation of 1,400 feet of sewer mains, 100 feet of storm drain mains, and 22 side sewers. Notable impacts under these alternatives (based on relocation costs, secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocations, and potential relocation of other localized utilities), include the relocation of 150 feet of 36-inch, 400 feet of 21-inch, 200 feet of 18-inch, and 750 feet of 12-inch sewer main in the vicinity of Utah Avenue S, S Lander Street, and Third Avenue S.

Natural Gas

Alternative 5.1 (East Side of Third/Utah) could result in the least impacts to natural gas for this segment, requiring relocation of 1,800 feet of natural gas line. Alternative 5.1.2 (First Avenue S) could require relocation of 1,800 feet of line. Alternatives 5.2/5.2(s) (West Side of Third/Utah) could result in the greatest potential impacts, requiring relocation of 2,600 feet of natural gas line in the vicinity of Third Avenue S and Utah Avenue S. These potential impacts are based on relocation costs, the secondary

impacts associated with concrete or asphalt replacement of the roadway following utility relocation, and potential relocation of other localized utilities.

Telecommunications, Fiber Optics, and Trolley Lines

Alternative 5.1 (East Side of Third/Utah) could require the relocation of 3,000 feet of overhead phone lines and 800 feet of underground FO/TV lines. Alternative 5.1.2 (First Avenue S) could require the relocation of 2,800 feet of overhead phone lines and 3,000 feet of overhead FO/TV lines, the greatest impact to FO/TV. Alternatives 5.2/5.2(s) (West Side of Third/Utah) could have the greatest impact to telephone lines in the SODO Segment, requiring the relocation of nearly 4,900 feet of overhead phone lines but only 400 feet of overhead FO/TV lines. No Metro trolley lines would be affected by these alternatives.

Within this segment, some overhead utilities could be relocated underground, resulting in potential secondary impacts to roads, sidewalks, and adjacent businesses or services. Portions of overhead utility lines could require underground relocation in approximately 15 locations for Alternatives 5.1 and 5.2 and 23 locations for Alternative 5.1.2 (BERGER/ABAM 2003b).

Preferred Alternative (Impact Summary)

Alternative 5.2(s) (West Side of Third/Utah – single beam) with Safeco Station

This alternative could require the relocation of 100 feet of 8-inch ED and 400 feet of 18-inch ED along Third Avenue. Approximately 6,000 feet of overhead electrical lines could require relocation with this alternative. This alternative also crosses transmission lines at Utah Avenue S and S Hanford Street, and again at Third Avenue S and S Holgate Street. The use of Alternative 5.2(s) with a station at Safeco Field could result in proportionately lower impacts to water service, but substantially higher impacts to natural gas, sewer, storm, and telephone lines. The alignment refinement in the Lander area has been designed to minimize impacts to railroad tracks.

Segment 6: West Seattle Segment

Electrical Service –

Alternative 6.1/6.1(s) - West Seattle I

Underground: No underground electrical facilities would be affected by this alternative.

Overhead: Approximately 12,050 feet of overhead electrical lines could require relocation with this alternative. The Morgan Junction station, located at SW Beveridge Place and California Avenue SW, could require the underground relocation of one set of distribution lines (150 feet). At California Avenue SW and SW Graham Street, the underground relocation of 100 feet of supply line is proposed for this alternative. The Alaska Street station, located on SW Alaska Street, could require underground relocation of two sets of distribution lines and one supply line, totaling 450 feet. Along Fauntleroy Way between SW Oregon and SW Avalon, 750 feet of distribution lines could be relocated underground. The Avalon 1 (Center) station would require relocation of another 200 feet of distribution line, while an additional 150 feet would be relocated along SW Avalon Way at 35th Avenue SW. On S Horton Street at the Alaskan Way Viaduct, another 250 feet of distribution lines could require underground relocation. This alternative also crosses transmission lines at the West Seattle Bridge. The proposed approach to crossing these transmission lines is to raise the transmission lines over the guideway. Alternatives 6.1A (Delridge to Yancy Breakout) and 6.1.6/6.1.6(s) (West Side of California) would impact over

17,000 feet of overhead distribution and supply lines, and 100 power poles; Alternative 6.1.1 (Past Pigeon Point) would impact approximately 13,100 feet of overhead lines and 100 power poles. Alternative 6.1.4 (Andover/Yancy Subsegment) would affect approximately 12,900 feet of overhead lines and 60 power poles.

New poles could be required along California Avenue SW at SW Beveridge and SW Edmunds Street; along Fauntleroy Way SW at 36th Avenue SW, 38th Avenue SW, and SW Avalon Way; along SW Avalon Way at 35th Avenue SW; Along SW Yancy Way at 30th Avenue SW; and along SW Andover Street at 26th Avenue SW (BERGER/ABAM 2003b). City Light estimates a need for 100 new poles for this alternative (City Light 2003c).

Alternative 6.2 – West Seattle II

Underground: This alternative could require the relocation of 300 feet of 12-inch underground ED along S Horton Street. Impacts of Alternatives 6.2.1 (North Side of Alaska to 35th) and 6.2.2 (Center of 35th) would be similar to those for Alternative 6.2.

Overhead: Approximately 15,000 feet of overhead electrical lines could require relocation with this alternative. Along California Avenue SW at SW Willow Street, approximately 900 feet of distribution lines would require underground relocation, 200 feet of supply line would be relocated underground at SW Graham Street, and another 450 feet of distribution lines relocated underground at SW Hudson Street. On SW Edmunds Street, one set of distribution lines (200 feet) at California Avenue SW, and another set (100 feet) at the alley behind 43rd Avenue SW would be relocated underground. Along SW Alaska Street, 1,300 feet of distribution and supply lines would be relocated underground. Along 35th Avenue SW, 1,200 feet of distribution and supply lines would be relocated underground. This alternative does not cross any transmission lines (BERGER/ABAM 2003b). Impacts of Alternative 6.2.1 (North Side of Alaska to 35th) and 6.2.2 (Center of 35th) would be similar to those for Alternative 6.2. *New poles could be required along California Avenue SW at SW Eddy Street, SW Graham Street, and SW Brandon Street.* New poles could also be required for 1,050 feet of SW Avalon Way between 35th Avenue SW and SW Yancy Street.

Alternative 6.3(s) – Delridge North Subsegment

Underground: There are no impacts to underground power for this alternative.

Overhead: Approximately 16,000 feet of overhead electrical lines could require relocation with this alternative. This alternative would cross two transmission lines and require approximately 100 new power poles.

Alternative 6.4 or 6.4(s) – Andover/Yancy Subsegment

Underground: There are no impacts to underground power for this alternative.

Overhead: Impacts of this alternative are similar to those for 6.1A as noted above, including over 17,000 feet of overhead distribution and supply lines, and 100 power poles.

Alternative 6.5 – Genesee Subsegment

Underground: There are no impacts to underground power for this alternative.

Overhead: Approximately 15,000 feet of overhead electrical lines could require relocation with this alternative. This alternative would cross two transmission lines and require approximately 100 new power poles.

Water Supply

Alternatives 6.1/6.1(s) (West Seattle I), 6.1.2 (To Pigeon Point), and 6.1.4 (Southeast Side of Fauntleroy) would result impacts to 7,400 feet of water main and 200 service connections. Alternative 6.1.6/6.1.6(s) (West Side of California) would have reduced impact to water, requiring the relocation of 5,900 feet of line. On a short-term basis during construction, these alternatives could result in potential displacements to multiple users on the system. Notable impacts under these alternatives include the relocation of 4,800 feet of 12-inch and 2,600 feet of 8-inch waterline in the vicinity of California Avenue SW, Avalon Way SW, and SW Yancy Street (BERGER/ABAM 2003a). Potential relocations under Alternatives 6.1, 6.1.2, and 6.1.4 could be quite costly and could result in secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocation, and potential relocation of other localized utilities. Alternative 6.2 (West Seattle II) 6.2.1 (North Side of Alaska to 35th), 6.2.2 (Center of 35th), and 6.1.6 (West Side of California) would result in proportionately lower but similar impacts, with 5,600 feet of water main and 124 to 128 service connections affected.

Sanitary Sewer and Storm Drains

Alternatives 6.1 (West Seattle I), 6.1.2 (To Pigeon Point), and 6.1.4 (Southeast Side of Fauntleroy) could result in the greatest potential impacts to sewer with each alternative, potentially requiring relocation of 5,350 feet of sewer mains, including 200 side sewers. Notable impacts under these alternatives, based on relocation costs, secondary impacts associated with concrete or asphalt replacement of the roadway following utility relocations, and potential relocation of other localized utilities, include the relocation of 300 feet of 21-inch, 350 feet of 18-inch, 500 feet of 15-inch, 1,300 feet of 12-inch, 700 feet of 10-inch, and 1,550 feet of 8-inch sewer main in the vicinity of California Avenue SW (BERGER/ABAM 2003a). Alternatives 6.1A (Delridge to Yancy Breakout) and 6.1.6/6.1.6(s) (West Side of California) would impact 1,400 feet of combined sewer mains and 49 side sewers.

Alternatives 6.2 (West Seattle), 6.2.1 (North Side of Alaska to 35th), and 6.2.2 (Center of 35th) could result in slightly lower impacts comparatively, requiring relocation of 3,500 to 3,700 feet of sewer mains and 61 side sewers. Alternative 6.2 would also affect 500 feet of storm drains. Alternative 6.2.2 would affect an additional 515 feet of 12-inch sewer pipe.

Natural Gas

Alternative 6.1/6.1(s) (West Seattle I) could result in relocation of 550 feet of natural gas line. Alternative 6.1.4 (Southeast Side of Fauntleroy) could result in slightly higher impacts, requiring relocation of 700 feet of line. Alternatives 6.2 (West Seattle II), 6.2.1 (North Side of Alaska to 35th), and 6.2.2 (Center of 35th) could result in the greatest potential impacts, requiring relocation of 1,300 feet of natural gas line. Notable impacts under this alternative include the relocation of 900 feet of 12-inch high-pressure gas line in the vicinity of 35th Avenue SW (BERGER/ABAM 2003a). Alternative 6.1.2 (To Pigeon Point) would have no impact to natural gas lines.

Telecommunications, Fiber Optic, and Trolley Lines

Alternatives 6.1 (West Seattle I), 6.1A (Delridge to Yancy Breakout), and 6.1.6/6.1.6(s) (West Side of California) could require relocation of 7,100 feet of overhead telephone and 6,550 feet of overhead FO/TV lines. Alternative 6.1.2 (To Pigeon Point) could have the greatest impact, requiring relocation of

7,200 feet of overhead telephone and 6,550 feet of overhead FO/TV lines. Alternative 6.1.4 (Southeast Side of Fauntleroy) could require relocation of 7,200 feet of overhead telephone and 5,650 feet of overhead FO/TV lines. Alternatives 6.2 (West Seattle II), 6.2.1 (North Side of Alaska to 35th), and 6.2.2 (Center of 35th) could have the least potential impacts, requiring relocation of 4,900 feet of overhead telephone and 7,350 feet of overhead FO/TV lines.

Within this segment, some overhead utilities could be relocated underground, resulting in potential secondary impacts to roads, sidewalks, and adjacent businesses or services. Portions of overhead utility lines could require underground relocation in approximately 10 different locations for Alternatives 6.1 and 6.1.2, seven locations for Alternative 6.1.4, and 16 locations for Alternatives 6.2, 6.2.1, and 6.2.2 (BERGER/ABAM 2003b).

Preferred Alternative (Impact Summary)

Alternatives 6.1.1(s) on the West Seattle Bridge, 6.3(s) (Delridge North Subsegment) from West Seattle Bridge to SW Avalon Way; 6.2.2 (Center of 35th/North Side of Alaska) from SW Avalon Way to SW Alaska Street; 6.1 in the Alaska Junction; and 6.1.6(s) (West Side of California) from 42nd Avenue SW to Morgan Junction.

Between 6,000 and 12,000 feet of overhead electrical line could require relocation with the Preferred Alternative, however, impacts to power lines on Fauntleroy Way SW would be minimized by following Alternative 6.2.2 along the center of 35th Avenue SW. This option would substantially increase impacts to natural gas, and would add an impact to storm drains.

Alternative 6.1.6(s) (West Side of California) would have reduced impact to water, requiring the relocation of 5,900 feet of line, and would substantially minimize the impact to sewer lines along California Avenue SW, bringing the estimated impact down approximately 4,000 feet.

Station Alternative Impacts

Construction of columns in station areas, at the Operations Center, and for power substations could require demolition of existing buildings and removal of existing sidewalks, curbs, and paving. New utilities would be provided underground for services required in the station, such as potable drinking water, fire, power, sewer, storm drains, communications, and closed-circuit television. Irrigation systems could be constructed as desired (SMP 2003b). Utilities adjacent to proposed stations could also potentially be affected during construction staging, facility construction, and guideway construction. For stations, utility relocations are expected to be minimal in comparison to the alignment alternatives, because they would use thinner, more easily placed columns (BERGER/ABAM 2003a).

The potential construction impacts to stations are summarized below by segment. The alignment utility impacts were factored into the station impacts wherever possible to minimize duplication. Therefore, if the station location compromises a utility already considered in the alignment impacts, it is not addressed as a station impact.

Segment 1: Ballard Segment

NW Market 1 (Southwest), and Crown Hill 1 (West, 85th) stations incur no impacts to utilities for those services not already affected by the guideway. NW Market 2 (Center) would require an additional relocation, removal, or decommissioning in place of 200 feet of abandoned gas line. NW 65th 1 (West) could require an additional relocation of 100 feet of 6-inch storm drain. NW 65th 2 (Center) could require

an additional relocation of 250 feet of 10-inch gas line. Crown Hill 2 (Center) could require an additional relocation of 300 feet of 4-inch gas line.

Preferred Alternative (Impact Summary)

Crown Hill 1A – No additional impacts

NW 65th 1B – 100 feet of 6-inch storm drain

NW Market 3A – No additional impacts

Segment 2: Interbay/Magnolia Segment

Dravus 1 (16th) station location is above a detention tank. Dravus 2 (15th), Howe 1 (West), Prospect 3 (West), Elliott and Mercer 1 (Center), and Elliott and Mercer 2 would incur no impacts to utilities not already affected by the guideway.

Preferred Alternative (Impact Summary)

Dravus 1B – No additional impacts

Future Howe 1A (Blaine) – No additional impacts

Elliott and Mercer 1A – No additional impacts

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Seattle Center/Queen Anne 1 (North), Seattle Center/Queen Anne 2 (South), Seattle Center/Fifth and Broad 2 (Harrison), Denny 3, Belltown 1 (Center), and Belltown 3 (West) stations incur no impacts to utilities not already compromised by the guideway.

Preferred Alternative (Impact Summary)

Seattle Center/Queen Anne 1A – No additional impacts

Seattle Center/Fifth and Broad 1A – No additional impacts

Belltown 1A – No additional impacts

Segment 4: Downtown/Pioneer Square Segment

Fifth & Stewart 1 (Northwest) and Fifth & Stewart 2 (Virginia) would incur no impacts to utilities not already affected by the guideway. Lenora 3 (West) could affect an 18-inch electrical duct bank on the west side of Fifth Avenue. Neither Pike 1 (West), Madison 1 (West), or Yesler 1 (West) would incur any impacts to utilities not already affected by the guideway. None of the center station options with Alternative 4.3 (including Pike 3, Madison 2, and Yesler 2) would affect utilities not already affected by the guideway.

Preferred Alternative (Impact Summary)

Fifth & Stewart 2A – No additional impacts

Pike 1 – No additional Impacts

Madison 1 – No additional impacts

Yesler 1 – No additional impacts

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

For station options Weller/King Street 1 (Standard), Safeco Field 1, Lander 1 (Northeast), Lander 3 (Diagonal), no impacts to utilities would occur for those services not already affected by the guideway. For Weller/King Street 2 (Event) additional impacts would occur to a 6-inch water line (350 feet) and 18-inch underground electrical duct bank (400 feet).

Preferred Alternative (Impact Summary)

Weller/King Street 2 – Impacts to 6-inch water line and electrical duct bank

Safeco Field 1 – Impacts to two additional sets of distribution lines (600 feet).

Lander 3 (Diagonal) – No additional impacts

Segment 6: West Seattle Segment

Delridge 1 (26th), Delridge 1A (26th), Avalon 1 (Center), Avalon 2A (35th), Avalon 2B (West side of 35th), Alaska Junction 1 (42nd/Edmunds), Morgan Junction 1 (West), and Morgan Junction 2 (Center) would incur no impacts to utilities not already affected by the guideway.

For Delridge 2 (Andover), additional impacts would occur to a 24-inch sanitary sewer pipe (400 feet) and a 30-inch sanitary sewer pipe (400 feet), both along SW Andover Street just west of 26th Avenue SW. Alaska Junction 2 (44th/California) could require additional relocation of an 8-inch water line (300 feet) and a 15-inch sanitary sewer pipe (600 feet).

Preferred Alternative (Impact Summary)

Delridge 3 – No additional impacts

Avalon 2B – No additional impacts

Alaska Junction 1 – No additional impacts

Morgan Junction 1A – No additional impacts

Mitigation

The following potential mitigation measures are divided between typical systemwide measures and measures applied to specific utility services. When implemented, these measures could reduce the potential impacts of Green Line construction on utility services and infrastructure.

Typical Potential Mitigation Measures

- Work closely with utility purveyors to reduce any potential service interruptions. Potential service disruptions would likely be minimal because temporary or new permanent connections to customers would typically be established before relocating utility conveyances.
- Continue to meet with and coordinate closely with both municipal and private utilities to reduce impacts. As part of long range planning, develop plans for relocation and construction sequencing acceptable to the utility purveyors, and design protection of their facilities into the column foundation design that will allow the purveyors access to adjacent facilities. Coordinate service connections on the private portion of the utility being moved with the private property owner.
- Following the installation of utilities and construction of the foundations and columns for the monorail guideway, construct the roadways to the final design, and restore the streetscape. This

would include concrete curbs, sidewalks, and asphalt or concrete pavement. In areas of the street where concrete paving slabs have been removed for construction of the foundations, columns, and utility trenches, appropriate repairs/replacements would be completed.

- Conform to the 2003 edition of City of Seattle Standard Plans and Specifications for new utility construction.
- Coordinate with SPU to notify utility customers of planned service disruptions, including fire service relocations, retirements, and/or new service requests.
- Develop SMP general utility relocation and protection policies and procedures for crossings and installations.
- As part of long range planning, develop with SPU general utility relocation and protection policies and procedures that are acceptable to SPU. Comply with City and state requirements and procedures for utility construction, inspection, and operation.
- Before final design and construction, field-verify (by boring tests) the exact locations and depths of underground utilities at the proposed foundation locations and conduct condition checks as required.
- Modify column, foundation, or station locations as practicable to avoid and/or minimize a major utility relocation.
- If inadvertent damage to underground utilities occurs during construction due to uncertain locations or misidentification, contact the appropriate utility purveyor and begin repairing the damaged utility line immediately to restore service.
- Develop measures and policies with utility purveyors to address contingency plan requirements to manage any potential utility service disruptions during construction.
- Develop a stray current analysis to avoid adverse impact on utilities.
- Specify protective measures, such as pipe and conduit support systems, trench sheeting, vibration monitoring, and shoring during construction to minimize or avoid potential damage to all utilities within the zone of influence.
- Use construction techniques (e.g., drilled shafts vs. driven piles) to avoid vibration impacts to sensitive utilities.
- Obtain agreements with utilities and design monorail foundations to allow for maintenance trenching access to existing utilities without special shoring considerations need to be taken by the affected utility.

Potential Mitigation Measures for Electrical Service, Water Supply, and Sanitary Sewer/Storm Drains

- Maintain working relationships with City Light to provide continuous service to customers during construction, and comply with clearance of temporary and permanent overhead lines and poles according to Washington Administrative Code (WAC) safety standards and City Light clearance requirements.
- Work with City Light to develop a cost-effective solution and schedule for potential electrical duct bank relocations.
- Coordinate with City Light to provide safety watch and standby crew to minimize the interruption of power to the customers and to speed up the power restoration in the event of accidental interruption of power caused by the contractor.

- Keep construction activities 10 feet clear of cast-iron lead-joint water mains to avoid replacement. However, as the design details for the Green Line develop, spacing and protection measures more specific to the site and construction methods would be developed. Soil conditions and construction methods may require replacement of cast-iron lead-joint water mains outside of the 10-foot protection zone.
- Develop a plan with SPU for temporary water services and/or water mains during construction, with a sequencing plan for any water system construction.
- Coordinate with SPU water to maintain the required water services and pressure.
- Coordinate with the Seattle Fire Department and private property owners as necessary to maintain the required water flow for fire suppression and life safety purposes.
- Comply with Washington State Department of Health regulations, City of Seattle Water Quality Checklist (during construction), and 2003 City of Seattle Standard Plans and Specifications on disinfecting, flushing, and sampling new water mains.
- Coordinate water services affected by displacement of residences or businesses with SPU and the property owners.
- Coordinate with SPU throughout construction to repair, modify, or operate existing water facilities, including but not limited to water services, water mains, valves, test stations, and meters. (In the event of damage, contractor is to call the 24-hour dispatch line at 206-386-1800)
- Comply with applicable regulations regarding the maintenance of water supply for emergency service purposes.
- Engineer new sewer and storm sewer systems as appropriate and consistent with current City of Seattle Standard Plans and Specifications. Where ductile iron pipe is to be installed for the water utility, soil conditions must be analyzed to determine if the pipe needs to be wrapped.

Mitigation measures for the Preferred Alternative that have been committed to by SMP to date are discussed in Chapter 5, Mitigation Program.

4.17.11 Parks and Recreation

4.17.11.1 Impacts

Temporary construction activities may require revised access to some adjacent parks and recreational resources. Direct construction impacts that could temporarily affect park and recreational users include potential detours or travel lane reductions on a street rights-of-way and increased noise, dust, and truck traffic resulting from active construction. Indirect construction impacts could include temporarily increased traffic volumes on streets adjacent to parks because of traffic diversions and avoidance of construction zones. Potential construction impacts on specific parks and recreational resources in each segment of the Green Line are discussed below. Construction impacts would be similar to these under any of the alternatives.

Segment 1: Ballard Segment

- **Baker Park on Crown Hill.** Construction of any of the Crown Hill station alternatives near 15th Avenue NW and NW 85th Street would occur within approximately one block of Baker Park on Crown Hill. However, since the park is separated from the Green Line project area by commercial buildings and a large parking lot, construction impacts on this park are therefore expected to be low. Park users may experience temporary construction noise and dust, and some access may be revised in the area.

- **Ballard Swimming Pool.** Impacts due to construction of the NW 65th 2 Station alternative and placement of Green Line columns and guideway could result in temporary increases in noise, dust and truck traffic, and revised or altered access. On-street parking near the pool during the construction period may be revised or less convenient. Impacts from NW 65th 1, 1A, and 1B (Preferred Alternative) would be lower than NW 65th 2.
- **14th Avenue NW Boat Ramp.** Construction of the East Bridge (Alternative 1.2) could result in temporary impacts due to dust, noise, and traffic delay on the 14th Avenue NW Boat Ramp. Access to the ramp and nearby parking could be revised during Green Line construction.
- **Greg's Garden.** Impacts to Greg's Garden could be similar to those at the 14th Avenue NW Boat Ramp. There could be temporary impacts due to dust, noise, and traffic delay.

Segment 2: Interbay/Magnolia Segment

- **Interbay Athletic Complex and P-Patch.** The athletic complex is a large, active, open-air recreational facility that is subject to existing noise associated with heavy auto and truck traffic on 15th Avenue W, as well as trains operating on the nearby BNSF railroad. Temporary construction impacts under either alignment alternative may include increased noise, dust, and truck traffic; and revised or altered access. Impacts are likely to be slightly greater under Alternative 2.1/2.1(s) (Preferred Alternative) due to closer proximity to the parks.
- **Queen Anne Greenbelt and Kinnear Park.** Users of the Southwest Queen Anne Greenbelt and Kinnear Park may experience minor increases in noise associated with relocation of utilities and construction of Green Line columns and guideway.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Impacts on Tilikum Place could include temporary construction noise and dust and traffic delays. This impact would be similar for any alternative. See Section 4.3, Land Use and Neighborhoods, and Section 4.5, Visual Quality and Aesthetic Resources, for discussions of Seattle Center.

Segment 4: Downtown/Pioneer Square Segment

Construction impacts to parks in the Downtown/Pioneer Square Segment would be similar for any of the alternatives.

- **Union Station Square.** Temporary construction impacts could include closure or physical separation of the square (e.g., fencing of a street right-of-way); increased noise, dust, and truck traffic; and revised or altered access.
- **Pioneer Square Park.** Access to the park from the east could be restricted from Yesler Street. There could be increased dust, noise, and truck traffic associated with construction.
- **Westlake and Occidental Parks.** Westlake and Occidental Parks are each one block from alignment and station alternatives; therefore, impacts associated with construction of the Green Line are expected to be low. Westlake Park is physically separated from the Green Line guideways by tall buildings.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

No park resources would be affected by Green Line construction in the SODO/Chinatown International District/Pioneer Square Segment.

Segment 6: West Seattle Segment

- **West Duwamish and Pigeon Point Greenbelt.** Construction impacts to the green belt could include erosion, slides, and the removal of trees and vegetation for access, staging, and construction. There would be temporary noise and dust during construction. Alternative 6.1.2, which would travel through the greenbelt at Pigeon Point, would result in impacts to vegetation and views.
- **Longfellow Creek.** Construction impacts in the vicinity of Longfellow Creek Greenspace from Alternatives 6.1, 6.2, 6.4 or 6.5 could include temporary construction noise and dust, loss of parking, and access restrictions during intensive construction periods. Alternatives 6.3(s) (Preferred Alternative) would result in lower impacts to the Longfellow Creek Greenspace.
- **West Seattle Stadium Park.** Construction impacts would likely include increased noise, dust, and truck traffic and revised or altered access, which could impact recreation activities near the construction area. One station alternative (Avalon 2A) that was analyzed would be constructed on park property; however this station was not selected as the Preferred Alternative. The Preferred Alternative for this area (Avalon 2B station) would be located outside of the park and would not have direct impacts on park property.
- **Fauntleroy Place.** Construction impacts could include temporary increases in noise and dust.
- **West Seattle Golf Course.** Construction of Alternative 6.5 along SW Genesee Street could result in temporary impacts to access to the golf course, as well as increased noise, dust, and traffic activities near the construction area. Construction of any alternative would result in temporary access restrictions, but mitigation would ensure access during times of use.

4.17.11.2 Mitigation

Mitigation for construction impacts would primarily be those measures normally required as conditions for permit approval. These measures would include erosion control and mitigation and revegetation for Longfellow Creek Greenspace, West Duwamish Greenbelt, and West Seattle Stadium Park on 35th Avenue SW. Construction plans would include safe access to the park and its recreational resources. Please see Chapter 5, Mitigation Program, for more information.

4.17.12 Cultural Resources

4.17.12.1 Impacts

Archaeological Resources

Potential significant impacts to unknown hunter-fisher-gatherer, ethnographic period, and historic period archaeological resources in project alternatives are summarized by segment, alignment alternatives, and station in Table 4.17-10. Construction excavation in areas with a high probability for unknown archaeological resources may affect the archaeological resources. Construction excavation in areas with a moderate or low probability for unknown archaeological resources will probably not affect archaeological resources. Areas with a moderate or low probability for archaeological resources are listed as No effect in Table 4.17-10.

Historical Resources

Historical Resources within the APE of project alternatives and staging areas would experience proximity effects due to demolition, utility relocation, and construction of the support columns, bridges, guideways, and the stations for the Green Line. The resulting effects would include visual impacts, temporary access

restrictions, increased truck traffic in the vicinity, possible street closures and resulting traffic detours, increased noise and/or vibration related to the use of heavy equipment and pile driving, and dust. The demolition of historic resources is considered a long-term effect and is not repeated here. Otherwise, all of the resources identified as experiencing long-term adverse effects in Table 4.17-10 would also be likely to encounter some or all of the short-term effects listed above.

To mitigate for temporary access restrictions, increased truck traffic in the vicinity, possible street closures and traffic detours SMP would work with the City of Seattle to plan detours that have the least impact possible on access to historic buildings. An Access Mitigation Plan may be developed as part of the undertaking (refer to Section 4.1, Transportation).

Of the potential short-term impacts, the greatest potential for effects to historical resources would involve vibration impacts that could damage historic structures, as discussed earlier in Section 4.17.8.2.

The construction vibration threshold criteria for historic buildings was set at 100 VdB for fragile buildings (including historic structures of precast concrete, well-maintained wood, or steel) and 95 VdB for extremely fragile buildings (including the Pioneer Square Areaways, D-127 and the areaway (D-128, D-129) associated with Times Square Building and the Columbia Building) and historic structures of unreinforced masonry, large concrete block, and load bearing timber structures). Pile driving is potentially the greatest source of vibration associated with equipment used during construction of the Green Line. Typically, buildings within 25 to 50 feet of the vibration-causing activity would have a higher potential to be affected, buildings within 50 to 100 feet would have a moderate potential to be affected, buildings within 50 to 100 feet would have a moderate potential, and buildings more than 100 feet away would have a lower potential.

To control vibration impact from pile driving or any other major vibration source a monitoring program will be established. The monitoring program with a stop work procedure for sensitive structures is the most reliable way to minimize vibration impact during construction. The measured vibration levels are radiated through the existing soil and give real impact levels. Instead of reviewing the soil conditions and calculating impact levels (which is a very complex calculation with a large margin of error) the described procedure will accurately measure the vibration impact levels independent from the soil conditions. Should measured vibration levels exceed the thresholds established by the FTA Guidelines work would be stopped and alternative construction methods and or mitigation treatments would have to be implemented before work could continue.

A vibration monitoring program similar to the underground utility monitoring will be implemented for all activities that produce vibration levels above 0.12 inch/second or 95 VdB re 1 micro inch/second whatever is more stringent. This program is discussed above under Noise and Vibration Mitigation.

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources in Project Alternatives

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	Preferred Alternative (PA)	Construction of bridge supports may affect unknown hunter-fisher-gatherer archaeological resources	Construction of bridge supports may affect unknown ethnographic period archaeological resources	No effect
	1.1.1 West Bridge	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	1.1.2 Far West Bridge	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	1.1.1(s) West single beam guideway bridge	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	1.2 East Bridge	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Segment 2: Interbay/Magnolia				
	2.1 - West Side of 15 th /Center of Elliott	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs
	2.1(s) – West side of 15 th /Center of Elliott with single beam	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs
	2.2 - Center of 15 th /West Side of Elliott	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	Preferred Alternative (PA)	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs
	Operations Center	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	2.1.1 West Bridge Connection	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	2.1.2 Far West Bridge Connection	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Howe 1 (West)	2.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Howe 1A (Blaine)	2.1, (PA future)	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Howe 2 (Center)	2.2	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Prospect 3 (West)	2.2	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Elliott and Mercer 1 (Center)	2.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Elliott and Mercer 1A (Center)	2.1, PA	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Elliott and Mercer 2 (West)	2.2	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Segment 3: Queen Anne/Seattle Center/Belltown				
Seattle Center/Fifth and Broad 1	3.1, 3.3	No effect	No effect	May affect unknown historic period archaeological resources

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Segment 4: Downtown/Pioneer Square				
	4.1 - West Side of Second	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown ethnographic period archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown historic period archaeological resources in the Yesler Way and S King Street vicinity
	4.2 - East Side of Second with Crossover	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown ethnographic period archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown historic period archaeological resources in the Yesler Way and S King Street vicinity
	4.3 - Center of Second	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown ethnographic period archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown historic period archaeological resources in the Yesler Way and S King Street vicinity
	4.4 – East of Center Option	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown ethnographic period archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown historic period archaeological resources in the Yesler Way and S King Street vicinity

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	Preferred Alternative (PA)	Alignment may affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity. The station on the West side of Second at Yesler may affect unknown hunter-fisher-gatherer archaeological resources	Alignment may affect unknown ethnographic period archaeological resources in the Yesler Way and S King Street vicinity. The station on the west side of Second at Yesler may affect unknown ethnographic period archaeological resources	Alignment may affect unknown historic period archaeological resources in the Yesler Way and S King Street vicinity. Stations on the West side of Second near Pike, Madison, and Yesler may affect unknown historic period archaeological resources
Pike 1 (West) A	4.1	No effect	No effect	May affect unknown historic period archaeological resources
Pike 1 (West) B	4.1, PA	No effect	No effect	May affect unknown historic period archaeological resources
Pike 2 (East)	4.2	No effect	No effect	May affect unknown historic period archaeological resources
Pike 2A (East Center)	4.4	No effect	No effect	May affect unknown historic period archaeological resources
Pike 3 (Center)	4.3	No effect	No effect	No effect
Madison 1 (West)	4.1, PA	No effect	No effect	May affect unknown historic period archaeological resources
Madison 2 (East)	4.2	No effect	No effect	May affect unknown historic period archaeological resources
Madison 2A (East Center)	4.4	No effect	No effect	May affect unknown historic period archaeological resources
Madison 3 (Center)	4.3	No effect	No effect	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Yesler 1 (West)	4.1, 4.2, 4.4, PA	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	May affect unknown historic period archaeological resources
Yesler 2 (Center)	4.3	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	May affect unknown historic period archaeological resources
Segment 5: SODO/Chinatown International District/Pioneer Square				
	5.1 - East side of Third/Utah	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	May affect unknown ethnographic period archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	No effect
	5.2 - West side of Third/Utah	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	May affect unknown ethnographic period archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	5.2(s) – West Side of Third/Utah with single beam guideway	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	May affect unknown ethnographic period archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	No effect
	Preferred Alternative (PA)	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	May affect unknown ethnographic period archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	No effect
	5.1.1 Utah Avenue S	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	5.1.2 First Avenue S	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Weller/King Street 1 (Standard)	5.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Weller/King Street 2 (Event)	5.2, 5.2(s), PA	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Safeco Field 1	5.1, 5.2(s), PA	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Lander 1 (Northeast)	5.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Lander 2 (Southwest)	5.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Lander 3 (Diagonal)	5.2, 5.2(s), PA	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Lander 4 (Utah)	5.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Segment 6: West Seattle				
	6.1 – Duwamish Crossing West Seattle Bridge dual beam guideways	May affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity
	6.1(s) – Duwamish Crossing West Seattle Bridge single beam guideway	May affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	6.2 – Duwamish Crossing new monorail-only West Seattle Bridge	May affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity
	6.3(s) – Delridge Subsegment Delridge North single beam guideway	May affect unknown hunter-fisher-gatherer archaeological resources in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources in the lower reach of Longfellow Creek	No effect
	6.4 – Delridge Subsegment Andover/Yancey	May affect unknown hunter-fisher-gatherer archaeological resources in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity
	6.4(s) – Delridge Subsegment Andover/Yancey single beam guideway	May affect unknown hunter-fisher-gatherer archaeological resources in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	6.5 Delridge Subsegment Genesee	May affect unknown hunter-fisher-gatherer archaeological resources in the lower reach of Longfellow Creek	May affect unknown ethnographic period archaeological resources in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources
	Preferred Alternative (PA)	Alignment may affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	Alignment may affect unknown ethnographic period archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	Alignment may affect unknown historic period archaeological resources in the Delridge Way vicinity
	6.1.1 Duwamish Crossing past Pigeon Point	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
6.1.2 To Pigeon Point	6.1.2 Duwamish Crossing to Pigeon Point	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
	6.1.1(s) Duwamish Crossing past Pigeon Point	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-10. Summary of Potential Significant Impacts to Unknown Archaeological Resources (continued)

Segment and Station Name	Alignment Alternatives	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
	6.1.2(s) Duwamish Crossing to Pigeon Point	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Delridge 1 (26 th)	6.1	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	May affect unknown historic period archaeological resources
Delridge 1A (Delridge and Andover)	6.4	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown historic period archaeological resources
Delridge 2 (Andover)	6.2	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	May affect unknown historic period archaeological resources
Delridge 4 (Genesee)	6.5	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	May affect unknown historic period archaeological resources
C-2 SODO		May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect

Table 4.17-11. Summary of Potential Significant Impacts to Unknown Archaeological Resources for Preferred Alternative

Alignment and Station Name	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Ballard Bridge Alignment	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
16 th Avenue W	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	No effect
15 th Avenue W Alignment (from Garfield overpass to W. Barrett Street)	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs
Howe/Blaine Station	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Operations Center	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Elliott Street Alignment (to Garfield overpass)	May affect unknown hunter-fisher-gatherer archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown ethnographic period archaeological resources in Salmon Bay, on Smith Cove, and on the former tideflats and shoreline of Elliott Bay	May affect unknown historic period archaeological resources on the former shoreline of Elliott Bay and at the base of bluffs
Mercer Station	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown ethnographic period archaeological resources	No effect
Broad Street Station	No effect	No effect	May affect unknown historic period archaeological resources
Second Avenue Alignment	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity	May affect unknown hunter-fisher-gatherer archaeological resources in the Yesler Way and S King Street vicinity
Pike Station	No effect	No effect	May affect unknown historic period archaeological resources
Madison Station	No effect	No effect	May affect unknown historic period archaeological resources

Table 4.17-11. Summary of Potential Significant Impacts to Unknown Archaeological Resources for Preferred Alternative (continued)

Alignment and Station Name	Significant Hunter-Fisher-Gatherer Resources	Significant Ethnographic Period Resources	Significant Historic Period Resources
Yesler Station	No effect	No effect	May affect unknown historic period archaeological resources
North SODO Alignment, north of Safeco to Yesler Station	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown historic archaeological resources
Weller/King Station	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity	No effect
Safeco Field Station	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	No effect
SODO Alignment, Third Avenue S – between Lander and Safeco	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	No effect
Lander Alignment	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	No effect
South SODO Alignment	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott Bay	May affect unknown hunter-fisher-gatherer archaeological resources in the S King Street vicinity and on the former tideflats of Elliott	No effect
West Seattle Bridge	May affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown hunter-fisher-gatherer archaeological resources on the former tideflats of Elliott Bay, the north end of Pigeon Point, and in the lower reach of Longfellow Creek	May affect unknown historic period archaeological resources in the Delridge Way vicinity
Delridge Station	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown hunter-fisher-gatherer archaeological resources	May affect unknown historic period archaeological resources in the Delridge Way vicinity

More information regarding historic resources and construction vibration effects from pile driving including individual building descriptions, distances to the alignment, sensitivity ratings, and construction vibration resulting in effects to historical buildings are described further in Table 4.17-6 and Appendix NN, Section 106 Cultural Resources Report.

4.17.12.2 Mitigation

Archaeological Resources

SMP reviewed mitigation measures for archaeological resources and traditional cultural properties with the Washington State Historic Preservation Officer (SHPO). SMP and SHPO agreed to pursue a Memorandum of Agreement (MOA) for archaeological resources. The MOA would be among the SMP, U. S. Coast Guard, City of Seattle, and OAHP. The U. S. Coast Guard would ensure that the undertaking is carried out in accordance with the agreement. The MOA would include provisions to deal with the discovery of unknown archaeological resources affected by the undertaking. The MOA would identify the responsible parties for complying with elements of the agreement, would outline the mitigation measures to be applied, and would bind the signatories of the agreement to comply with the mitigation measures. The MOA would clearly set forward mitigation measures and allow comment and review by the signatories and Tribes prior to implementation.

An Archaeological Treatment Plan and an Archaeological Construction Monitoring Plan would be prepared and attached as an appendix to the MOA. The plans would include provisions for advance training of archaeological staff to work in environments contaminated by hazardous materials. Archaeologists would consult with hazardous materials specialists during preparation of the Archaeological Treatment Plan and the Archaeological Construction Monitoring Plan to identify areas in advance of construction monitoring that may have hazardous materials below the contemporary ground surface. The Archaeological Treatment Plan and Supplemental Treatment plans will include provisions for recovery of perishable archaeological materials, such as artifacts of wood or fragments of baskets or matting, during archaeological data recovery excavation.

Archaeological construction monitoring would occur in bridge column locations and other areas with subsurface construction excavation that have a high probability for significant hunter-fisher-gatherer and ethnographic period archaeological resources in Salmon Bay, if column construction allows for direct observation of excavated subsurface sediments.

An Archaeological Treatment Plan would be developed when column locations and other areas with subsurface construction excavation have been finalized to minimize construction delays and to expedite agency and Tribal review in the event of an inadvertent archaeological discovery. An Archaeological Treatment Plan would include:

- Summary of the environmental and cultural setting of the APE, including probable kinds of archaeological resources.
- Archaeological research design with specific research problems for archaeological resources that may be present in the APE.
- Field and laboratory methodologies, including field techniques, data analysis, and data management procedures, for hunter-fisher-gatherer and ethnographic period archaeological materials that may occur in the APE.
- Reporting requirements and an outline of main subject headings in reports.
- Project schedules and the role of Supplemental Treatment Plans.

- Curation procedures, identification of permanent curation facilities, and discussion of consultation procedures with affected Tribes.
- Procedures for treating human remains and for consulting with the King County Medical Examiner, the Washington State OAH, and affected Tribes.
- Proposed activities to foster public participation in the undertaking and to disseminate results of investigations to the general public.
- Tribal consultation protocols and procedures.
- Schedule for progress reports.

Archaeological construction monitoring would occur in column locations and other locations that have a high probability for unknown archaeological resources, if column construction and subsurface excavation in other areas allow for direct observation of excavated subsurface sediments. A sample of areas with medium and low probabilities for archaeological resources will be monitored. An Archaeological Construction Monitoring Plan would include:

- A review of construction techniques.
- Monitoring procedures, techniques, and protocols.
- Reporting requirements.

Supplemental Treatment Plans would be developed as needed only if unknown archaeological resources are identified during archaeological construction monitoring. Preparation of Supplemental Treatment Plans would allow rapid response for specific archaeological resources inadvertently discovered in areas with subsurface construction excavation. A Supplemental Treatment Plan would be developed within 24 hours of resource discovery, reviewed by the SMP in 24 hours, and reviewed by the OAH and affected Tribes within 48 hours. Supplemental Treatment Plans would be developed for archaeological resources prior to conducting archaeological test excavations of resources identified during archaeological construction monitoring or that are determined probably eligible for listing in the NRHP. Specific research questions and field methods would be developed for affected archaeological resources, based on the research design in the Archaeological Treatment Plan. Please see Chapter 5 for specific mitigation commitments.

Historical Resources

The types of construction mitigation measures for all alternatives are the same as long term mitigation measures because the types of short-term construction impacts are the same (construction instability, introduction of new construction, temporary dirt damage, traffic noise, and visual effects). During construction of the Green Line, the City of Seattle may require the retention of granite sidewalks in the Downtown segment and historic preservation areas. The design for the extension of the sidewalks would be coordinated with the Seattle Design Commission.

In addition, monitoring for structural and vibration effects to historical resources (particularly unreinforced masonry, large concrete block, and load-bearing timber structures) along Second Avenue during construction could determine if mitigation is required (see Table N-3 for monitoring recommendations). As stated in Section 4.17.8, pile driving is potentially the greatest source of vibration associated with equipment used during construction, the use of vibratory pile drivers or an auger to install the piles instead of a pile driver could greatly reduce vibration levels. Prior to the construction of the Green Line, buildings that are sensitive to vibration impacts due to their construction methods will be

assessed. These buildings will then be monitored during construction. Details of the construction monitoring plan are included in Appendix NN as well as in Chapter 5, Mitigation Program.

4.17.13 Environmental Health

4.17.13.1 Impacts and Mitigation

Contaminated soils may be encountered at various upland sites during the construction of the project. Temporary sediment and erosion control Best Management Practices would be used to prevent contaminated soils from being washed offsite during soil excavation and removal activities. Refer to Section 4.12, Environmental Health, for further discussion of contaminated soils removal and disposal.

4.17.14 Earth

4.17.14.1 Impacts

Activities that could affect the geological conditions during the construction of any of the alternatives for the Green Line could include the following.

- **Construction-Induced Vibration and Settlement** – The methods under consideration for construction of the stations and guideway columns are drilled shafts and driven piles. Both of these methods have advantages and disadvantages. Driven piles generate little or no spoils (waste material removed from an excavation), do not require dewatering, and can densify adjacent loose soil. However, vibration associated with driven piles can cause settlement of loose soil and has the potential to damage nearby structures, pavement, and utilities. Drilled shafts generally do not produce significant vibration, but this method does generate more spoils and may require dewatering (US DOT 1998). The choice of method will be determined for each specific area of the alignment based on soil conditions, proximity to vibration-sensitive buildings, and neighborhood issues. Areas that would be more sensitive to pile driving include Pioneer Square (potential damage to historic buildings), Downtown Seattle (potential damage to buildings, relocation of utilities), and residential areas such as West Seattle (noise, vibration) (Garrett 2003). See Section 4.7, Noise and Vibration, for a more detailed discussion of construction vibration impacts. Soil and groundwater may be contaminated in areas where subsurface work would occur. Any contaminated material removed from drilled shafts would require special handling (see Section 4.12, Environmental Health).
- **Construction Period Erosion** – Construction of the Green Line and associated structures could have erosion impacts associated with soil exposed during station, guideway, and facility construction, soil removal, and soil stockpiling. Erosion could cause offsite transport of sediment that could impact and degrade surface water (US DOT 1998). Off-site transport of sediment could also affect public sewer systems.
- **Dewatering** – Dewatering may be necessary for subsurface work or utility construction. The process of dewatering lowers the groundwater, which could cause ground settlement and resulting damage to nearby structures and utilities. Groundwater removed during dewatering may be contaminated, and contaminated groundwater or groundwater with a high percentage of sediment may require special disposal methods (See Section 4.12, Environmental Health).
- **Construction-Related Excavations** – Temporary excavations may be necessary during guideway, station, and facility construction. Excavation of subsurface materials may affect nearby utilities, structures, and pavement.
- **Disposal of Soil Excavated During Construction** – At locations where Green Line alternatives involve construction on contaminated sites, soil removed from construction areas could be

contaminated and possibly unusable for construction. Contaminated soil may require special disposal methods. Section 4.12, Environmental Health, reviews the construction impacts related to known or potential soil or groundwater contamination.

4.17.14.2 Mitigation

A construction monitoring plan should be developed prior to drilling or driving of foundations, including a survey of adjacent structures. The plan would involve a vibration monitoring program to ensure vibration levels are below damage thresholds (Construction vibration is discussed in Section 4.17.8.2). Additional mitigation measures that may be employed include modifying the drilling or construction technique, installing recharge wells, and adding support to adjacent structures (US DOT 1998). In areas of documented groundwater contamination, an outer casing should be installed in foundation boreholes to prevent vertical migration of contamination (Seattle Popular Transit Plan Programmatic EIS 2002). For construction activities around landfills, the same mitigation options that were presented for landfill hazards in Section 4.13.3.1 also apply here.

Groundwater may be encountered during excavation of guideway and station foundations, and dewatering could be required. In some locations (see Section 4.12, Environmental Health), there may be the potential presence of contaminated groundwater. If the dewatering effluent is contaminated, it would require special handling and treatment, as discussed below. Construction techniques should be employed to minimize the amount of sediment and contaminants in discharge water prior to disposal. Settlement issues are also a concern with dewatering and should be handled as described above (US DOT 1998).

Impacts from excavation activities could be minimized through use of adequate shoring and by following the mitigation measures described above for construction vibration and settlement. These measures would reduce the impact of settlement to structures, utilities, and pavement. Using vibratory pile drivers or augered drills instead of impact pile drivers could reduce vibration. (See Section 4.17.8.2 for more detail.) Other construction impacts such as erosion of excavated soil could be mitigated by use of Best Management Practices.

Prior to construction, a hazardous materials management plan would be developed that addresses identification, notification, management, remediation, and disposal of hazardous substances. The plan would meet applicable standards and regulations for hazardous materials.

Landfill hazards could be mitigated through the development of a construction contingency plan specific for subsurface work on or adjacent to a landfill. The contingency plan could contain guidelines for handling, testing, and disposing of excavated material, which may be contaminated (see Section 4.12, Environmental Health). Landfill hazards could be mitigated through use of the appropriate drilling method to install drilled shafts through fill material that may contain obstructions. Landfill hazards could also be mitigated by monitoring the work zone for methane when drilling or driving shafts. As required by applicable regulations, methane control measures would also be implemented during design and construction of Green Line structures within 1,000 feet of a landfill.

4.17.15 Water

4.17.15.1 Impacts

The surface and groundwater related impacts for construction of the Green Line are discussed in this section. Groundwater related impacts associated with infiltrating dewatering water are also discussed in this Section. Section 4.14, Water, includes further detail related to relevant regulatory requirements and water impact analysis methodology. Construction of the Green Line is described below for individual

monorail components including stations, Operations Center, traction power substations, bridges, and guideways and columns. Because the components of the Green Line are the same for the different alternatives, construction methods would be similar. Construction impacts are discussed below for each component in general terms. Concerns unique to a segment or alternative are discussed individually for that particular segment. Stormwater quantity impacts are not expected during construction. New impacts would be expected to occur only on areas where new impervious area would be constructed. There are no new water quantity impacts from existing impervious areas. Construction site stormwater will be collected, retained or detained for treatment and, if discharged to the storm drainage system, discharged at controlled rates in accordance with applicable regulatory requirements, including applicable stormwater manuals. Water quantity best management practices for construction are described in Table 4.17-14 below.

With regard to water quality, the project would be required to obtain an NPDES permit for stormwater associated with construction activities. The project would also be required to obtain a Section 401 Water Quality Certification for construction of the Ballard Bridge and the work on the West Seattle Bridge. Both the NPDES permit and Section 401 Water Quality Certification would contain conditions to protect water quality. The project would also comply with applicable local surface and groundwater regulations. Potential water quality impacts with regard to construction are discussed below.

Contaminated Soils

Contaminated soils may be encountered at various upland sites during the construction of the project. Temporary sediment and erosion control best management practices would be used to prevent contaminated soils from being washed offsite during soil excavation and removal activities (Table 4.17-12). Refer to Section 4.12, Environmental Health, for further discussion of removal and disposal of contaminated soils.

Stations, Operations Center, and Traction Power Substations

All of the above listed construction activities associated with the Green Line have the potential to adversely affect receiving water bodies if sediment-laden water or other contaminants leave the construction area. Off-site water (water running onto the site) would be prevented from entering the construction site. Runoff from the site would be collected and, if necessary and feasible, treated on-site, before being discharged into the storm system or receiving water. However, if space or other constraints precluded on-site treatment, construction water would be discharged to the sanitary sewer system, after obtaining all necessary approvals and/or permits. An estimated range of construction runoff volumes that could be discharged to the sanitary sewer is summarized below in Table 4.17-12. Additional analysis with regard to potential construction impacts to water quality by segment is included in Table 4.17-13.

Table 4.17-12. Estimate of Construction Runoff to Sanitary Sewer^a

		Rainfall		Runoff Volume for 5 Month Period		Runoff Rate
Station	Area (acres)	Driest 5-month period (inches)	Wettest 5-month period (inches)	Minimum volume (cubic feet)	Maximum volume (cubic feet)	10-year peak (cubic feet per day)
Safeco Field 1	2.58	7.28	24.98	68,000	234,000	26,000

^a Rainfall data is from Normal Monthly Precipitation Data for the City of Seattle (NOAA)

To estimate the volume of stormwater that may be discharged into the sanitary sewer system, the largest station site (Safeco Field 1) was chosen for analysis. (Because the Operations Center site is assumed to be large enough to accommodate on-site stormwater treatment facilities, that site is not evaluated for

discharge to the sanitary sewer.) The volume of runoff is estimated based on an assumed construction period of five months. Seattle requires the use of the 10-year, 24-hour storm to size construction treatment BMPs. The volume of runoff expected from the Safeco site from design storm in a 24-hour period was also estimated.

The following section describes the Green Line impacts on Water quality for each segment. Table 4.17-13 summarizes the construction impacts by segment.

Table 4.17-13. Summary of Construction Impacts on Water Quality by Segment

Segment	Alternative	Length (Linear Feet)	Columns ^b	In-Water Columns	Stations	Operations Center ^a
Ballard	-	14,000	147	Yes	3	
Interbay/Magnolia	-	12,000	126	No	3	1
Queen Anne/Seattle Center/Belltown	3.1	7,300	77	No	3	
	3.2	8,800	93	No	3	
	3.3	6,900	73	No	3	
	3.5	6,800	72	No	3	
Downtown/Pioneer Square	-	6,700	71	No	4	
SODO/Chinatown International District/Pioneer Square	5.1	11,000	116	No	3	1
	5.2	10,400	109		2	
West Seattle	6.1	20,600	217	No	4	
	6.2	21,700	228		4	

^a Only one Operations Center would be constructed.

^b Number of columns is estimated from an average span length of 95 feet.

Segment 1: Ballard Segment

Construction of stations in the Ballard Segment could affect water quality in the Ship Canal. Transport of sediment or spills that could occur during construction activities could affect water quality where stormwater runoff discharges into the Ship Canal. Where stormwater discharges to the combined sewer, impacts are less likely. With the use of standard erosion control methods designed to prevent sediment and other contaminants from being carried off the construction site via stormwater, construction is not expected to have a significant adverse impact on water quality in the Ship Canal.

Impacts related to construction of a new bridge crossing the Ship Canal are discussed under Bridges and Columns later in this section.

Segment 2: Interbay/Magnolia Segment

Construction of stations, a possible Operations Center, guideway columns, and relocation of utilities could result in water quality impacts to stormwater entering Elliott Bay. However, with use of standard erosion control methods designed to prevent sediment and other contaminants from being carried off the construction site via stormwater, construction is not expected to have a significant adverse impact on water quality in Elliott Bay.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Construction through the Queen Anne/Seattle Center/Belltown Segment could affect the water quality of stormwater draining to Lake Union and Elliott Bay. The majority of the route through this segment is

located in combined sewer areas. Any accidental spills or erosion that occurred in this area would not affect local water bodies except in the case of a CSO event.

Segment 4: Downtown/Pioneer Square Segment

Construction in this segment is not expected to have any significant impacts to water quality in either Lake Union or Elliott Bay. The entire segment is located in a combined sewer area. Stormwater discharge to receiving water bodies occurs only during CSO events.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Unmitigated construction of stations, a possible Operations Center, guideway columns, and relocation of utilities could result in water quality impacts to stormwater entering Elliott Bay. However, with use of standard erosion control methods, construction is not expected to have a significant adverse impact on water quality in Elliott Bay because any sediment or other pollutants would be contained on-site.

Segment 6: West Seattle Segment

The West Seattle Segment of the Green Line proposes to cross the Duwamish Waterway. Potential water quality impacts associated with bridge construction are discussed under Bridges and Columns.

Alternatives 6.1, 6.2, 6.4, and 6.4(s) would each construct a station adjacent to Longfellow Creek. Stormwater from the station site could carry sediment or other contaminants into the creek. Alternative 6.1, involves construction of the guideway over the open channel of Longfellow Creek. Spills occurring over the open-water or in the adjacent riparian corridor could temporarily affect the water quality of the creek. Alternative 6.2 crosses Longfellow Creek along SW Andover Street where the creek is enclosed in a culvert. Water quality in the creek could be affected if construction spills or sediment entered catch basins connected to the stream, but impacts to the riparian corridor would not be expected. Alternatives 6.4 and 6.4(s) cross over the piped portion of Longfellow Creek approximately 45 feet south of SW Andover Street. Construction of these alternatives would likely require installation of one or more columns within the riparian corridor. Column construction within the corridor could temporarily affect water quality in the creek due to sediment or concrete washoff entering the creek. Alternative 6.5 would cross Longfellow Creek above SW Genesee Street, where the creek is enclosed in a culvert. However, if sediment, concrete washoff, or spills from column construction enter the catchbasins, the water quality of the creek could be temporarily affected. The use of standard sediment and erosion control BMPs would prevent or minimize these impacts. Alternative 6.3(s), the Preferred Alternative, is located approximately 1,400 feet downstream of where Longfellow enters the culvert at SW Andover Street. Therefore, this Alternative is not expected to affect the water quality of Longfellow Creek during construction.

Construction impacts to water quality in the remaining portions of the West Seattle Segment would be similar for all build alternatives. Construction of stations, guideway columns, and relocation of utilities could result in water quality impacts to stormwater entering the Puget Sound and the West Duwamish Waterway. The use of standard sediment and erosion control BMPs would also be used to prevent or minimize these impacts.

Wetlands

Construction of Alternatives 6.1, 6.4, and 6.4(s) would each require one or more columns to be constructed within the buffers of the two small wetlands adjacent to Longfellow Creek. Construction impacts and mitigation measures for construction within wetland buffers are discussed in Appendix RR, “Longfellow Creek Wetland Report” and Section 4.17-16 Plants and Animals.

Utility Relocation, Columns, and Guideway

A similar strategy of construction stormwater management would be applied to the guideways, columns, and utility relocation construction. Off-site stormwater would be directed away from construction activities. On-site water would most likely be directed to the sanitary sewer as on-site treatment would be difficult due to limited space. Potential water quality impacts are similar to those that could result from the stations, Operations Center, and traction power substations and are summarized in Table 4.17-14.

Table 4.17-14. Water Quality and Quantity Impacts from Land-based Construction

Impact	Cause	Potential Mitigation Measures/BMPs	Expected Outcome
Increased turbidity or sedimentation in receiving waters	Erosion of exposed soils and Demolition	Prevent tracking sediment off-site. Cover exposed soil. Protection of drainage inlets. Divert runoff away from exposed soil. Employ silt fence, sediment ponds, or other means sediment control. Enhanced treatment BMP (Chemical Treatment or Filtration)	Release of sediment – laden runoff to receiving waters would be reduced to allowable levels or avoided.
	Discharge of turbid dewatering water	Divert runoff from excavations Contain and properly dispose of dewatering water. Do not discharge turbid water to storm drains or receiving waters.	
Pollution from oil and grease, fuels, engine fluids, solvents, paint, pesticides, cleaning solutions, etc.	Application of paints, cleaning solutions, chemicals	Application shall be conducted in a manner to prevent loss of chemical to stormwater runoff.	Avoidance of adverse impacts to downstream waters through isolation and cleanup of hazardous construction materials.
	Spills/leaks from demolition and construction equipment or stored fluids	Covering and containment of stored fuels and chemicals. Spill control plan. Designated staging area for equipment maintenance.	
Elevated pH	Concrete work area runoff, demolition, & concrete saw cutting	Water from equipment washing would not be directly discharged to the storm system. Demolition debris would be handled and disposed of in a manner that does not cause contamination of stormwater. Slurry and cuttings would be vacuumed from saw cutting operations.	The pH of receiving waters would not be adversely affected.
Increased stream flows causing streambank erosion, bed scouring, and turbidity	Increased runoff to non-designated receiving waters during construction	Detention facility to control runoff rates to non-designated receiving waters. Alternatively, collection of stormwater and controlled discharge to the sanitary sewer.	Discharge of construction water to non-designated receiving waters at controlled rates, thereby reducing potential for increased streambank erosion, bed scouring, and turbidity.

Utility relocation, column, and guideway construction has been evaluated in one-block (300 feet) units for purposes of estimating time of construction, with each block having construction activity in the range of

three to five months. A range of construction stormwater runoff can be expected, depending on the time of year a typical block is under construction. If a center alignment is selected, up to three lanes (33 feet) of roadway could at times be affected by construction. Table 4.17-15 depicts a range of runoff from a one-block length of guideway during construction activities.

Table 4.17-15. Construction Runoff from One-Block of Guideway^a

Construction Area (square feet)	Rainfall		Runoff Volume		Runoff Rate
	Driest 5 Months (inches)	Wettest 5-Month Period (inches)	Minimum Volume (cubic feet)	Maximum Volume (cubic feet)	10-Year Peak (cubic feet per day)
9,900	7.28	24.98	6,000	21,000	2,300

^a Rainfall data is from Normal Monthly Precipitation Data for the City of Seattle (NOAA).

Bridges and Columns

There are two water crossings being examined by the Green Line, including the Ship Canal and the Duwamish Waterway. Table 4.17-16 summarizes potential impacts from in-water and over-water bridge construction activities.

Ballard Crossing

All alternatives in the Ballard Segment would require construction of a new bridge across the Ship Canal. Construction of the bridge at any of the three possible locations would require in-water and over-water work and could impact water quality. Each of the three bridge types (box girder, arch, and cable-stayed) would require in-water construction of columns and foundations in varying amounts. Barges with a crane and pile driver would be used to construct the columns. Up to two temporary trestles (one at the south end and one at the north end) of the Ship Canal would be installed to facilitate construction of the bridge. These temporary work trestles may be installed on both sides of the channel to expedite activities.

Without appropriate best management practices, over-water construction could have adverse impacts on water quality if spills or over-spray occurs. Without appropriate best management practices, in-water construction of columns, foundations, and temporary trestles could cause sediments to be stirred up and mixed with water in the Ship Canal, creating unacceptable turbid conditions or resuspension of contaminated sediments. The number of in-water columns depends on the type of bridge constructed. Table 4.17-17 depicts the range of columns that would be likely for each alternative bridge type.

Widths of spans and type of structure may vary during final bridge type, size, and location analysis. The number and location of columns used for analysis is a conservatively high estimate designed to bracket the final design and impacts. Each variation also impacts the column footprint size.

Table 4.17-16. Water Quality Impacts from Bridge Construction

Impact	Cause	Potential Mitigation Measures/BMPs	Expected Outcome
In-Water Work			
Increased turbidity or sedimentation in receiving waters	Discharge of turbid dewatering water	Contain and properly dispose of dewatering water. Reduction of turbidity.	Turbidity would be reduced to appropriate levels or not discharged.
Sediment	Disturbance of bottom sediment and contaminated sediment during in-water construction of columns and foundations.	Use of sediment containment methods such as cofferdams, filter sheeting, steel casing, or sealing of sediment by sunken barge. Excavated contaminated sediment would be contained in hopper barges for transport to upland disposal site or open-water disposal site if Washington State criteria for open-water disposal are met.	Disturbed sediment would be isolated from the surrounding water. Excavated contaminated sediment would be disposed of at an approved facility or approved open-water disposal site.
Elevated pH	In-water poured-in-place concrete work	Dewatering column construction area would isolate in-water concrete work.	The pH of receiving waters would not be adversely affected.
Over-water Work, Including Work from Barges			
Pollution from oil and grease, fuels, engine fluids, solvents, paint, cleaning solutions, etc.	Application of paints, cleaning solutions, chemicals	Application shall be conducted in a manner to prevent loss of chemical to receiving water. Over-water applications would employ a containment tent or other means of preventing over-spray from falling into the water.	Avoidance of adverse impacts to receiving waters through isolation and cleanup of hazardous construction materials.
Elevated pH	Concrete spills during concrete pouring activities	Formwork or a work platform would intercept spills from over-water concrete work.	The pH of receiving waters would not be adversely affected.

Ship Canal Sediments

Each Ship Canal crossing alternative near the Ballard Bridge would require installing support columns into contaminated silty sediments. Sediments may contain contaminants that could affect aquatic life if mixed in the water column, which could be avoided or minimized with the use of appropriate construction techniques and best management practices. If construction methods involved excavation of contaminated sediment, this sediment could be removed and disposed at an approved upland site in compliance with regulatory requirements. Sediments may also be characterized in accordance with Washington State Dredged Material Management Program (DMMP) protocols. This characterization may determine that all or part of the dredged sediments are non-contaminated and suitable for open-water disposal per DMMP guidelines.

Table 4.17-17. In-Water Columns for Differing Bridge Concept Types

Bridge Concept Type and Approach Span Lengths	Approximate Maximum Number of In-Water Columns	Approximate Minimum Distances from First In-Water Column to Shore
Box Girder (300-foot Main Span)		
150-foot Spans	11	50-100'
200-foot Spans	9	50-100'
300-foot Spans	6	50-100'
Box Girder (450-foot Main Span)		
150-foot Spans	10	50-100'
200-foot Spans	8	50-100'
300-foot Spans	6	50-100'
Steel Arch (500-foot Main Span with two 160-foot Flanking Spans)		
150-foot Spans	9	50-100'
200-foot Spans	8	50-100'
300-foot Spans	6	50-100'
Cable-Stay (600-foot Main Span with two 300-foot Flanking Spans)		
150-foot Spans	8	50-100'
200-foot Spans	7	50-100'
300-foot Spans	5	50-100'
Cable-Stay (900-foot Main Span with two 450-foot Flanking Spans)		
150-foot Spans	5	50-130'
200-foot Spans	4	50-130'
250-foot Spans	4	50-130'

The preferred method of column construction would use one to four shafts at varying depths and varying diameters. Six approach columns would utilize one 12-foot diameter shaft for the column foundation. Three columns supporting the main Bridge structure would require four 10-foot diameter drilled shafts for support. This would require a cofferdam for the three main bridge columns, the size of each cofferdam estimated to be 48 by 48 feet. If piles are used, a pile cofferdam could be constructed at each column site to allow sediment to be excavated within a dewatered enclosure. The depth of sediment excavated within the cofferdam has been preliminarily estimated at 22 feet. Therefore, based on these parameters, approximately 2,000 cubic yards of sediment would be excavated from within each cofferdam, and 100 cubic yards from each approach column shaft, for a total of approximately 7,000 cubic yards of sediment excavated for all bridge support columns. Sediment would be excavated from each cofferdam using suitable equipment operated from a barge-mounted crane or other appropriate and approved methods. For example, if the water content of the sediment is relatively low, a backhoe could operate within the cofferdam, loading dredged material into a skip pan and transferred to a barge. Excavated sediment and free water could be placed in a water tight barge or tanks mounted on barges. Contaminated sediment and associated water would be transferred to an upland staging area for proper disposal. Upland sediment handling areas would be constructed to install appropriate BMPs to contain any sediment or turbid runoff. Alternatively, free water in the hopper barge could be treated using settling tanks or another water treatment system meeting Washington State Surface Water Criteria before discharge of the water to the Ship Canal.

Sediments may also be characterized in accordance with the Washington State Dredged Material Management Program (DMMP) protocols. This characterization may determine that all or part of the

dredged sediments are non-contaminated and suitable for open-water disposal per DMMP guidelines. The DMMP represents a coordinated multi-agency approach to management of dredged materials in the State of Washington. The cooperating agencies include the U.S. Army Corps of Engineers – Seattle District, U.S. Environmental Protection Agency – Region 10, and the Washington Departments of Ecology and Natural Resources. By statutory requirement, the Washington State Department of Natural Resources (“DNR”), “provides, manages and monitors aquatic land disposal sites on state-owned aquatic lands for material dredged from rivers, harbors, and shipping lands.” DNR is responsible for management and environmental monitoring of eight unconfined open-water dredged material disposal sites around Puget Sound.

DNR, in consultation with other DMMP agencies, is responsible for conducting regularly scheduled environmental monitoring events at its open water disposal sites to verify that DMMP management guidelines are adequately protecting the environment against unacceptable adverse impacts. These monitoring events confirm whether deposited materials remain within the disposal site boundaries, the cleanliness of the materials disposed at the site, and the effect of dredged materials on local aquatic life.

Water quality impacts due to the project construction would be minor. Excavation of contaminated sediment within cofferdams would prevent releases of turbid water and contaminated sediment to the Ship Canal.

Water quality impacts from installation and removal of the cofferdams would also be minor. Installation of steel sheet piling for the cofferdams would cause little disturbance of sediment. Following construction of the columns, the sheet piles could be cut off at the sediment surface and the upper portions removed. This construction method, which avoids removal of the embedded portion of the sheet piles, would prevent disturbing contaminated sediment, such as might occur if the entire sheet piles were pulled from the sediment at the completion of the project.

An alternative construction method involves driving steel piles into the bottom of the Ship Canal at each support column location and covering them with a concrete cap to support a concrete or steel support column. Alternatively, drilled shafts or cast-in-place piles may be constructed in the substrate to support the concrete caps. The bridge column would be supported by foundations, the size of which would increase with longer spans. Although dewatering would be necessary, disturbance of contaminated sediment would be minimized.

Duwamish Waterway Bridge

Alternative 6.1 involves construction of the Green Line guideway above the deck of the existing West Seattle Bridge. This option would not require any permanent in-water structures, but could require over-water work to reinforce the existing bridge, and could require in-water work to construct temporary work trestles. Construction of the trestles could disturb sediment. Accidental spills during construction activities could adversely affect water quality in the Duwamish Waterways.

Alternative 6.2 involves construction of a new bridge adjacent to the existing West Seattle Bridge. A three-span, high-rise, box girder bridge would be constructed under this alternative. The three-span bridge design would avoid in-water construction; however, water quality could be affected by spills during over-water construction. Work from construction barges could potentially scour the river bed and resuspend sediments unless mitigated.

Placement of barges by tugboats during bridge construction activities could potentially re-suspend riverbed sediments. However, transportation of barges is a normal ongoing activity that takes place in the navigable water of the Duwamish River and would not pose any new impact.

4.17.15.2 Mitigation

Appropriate construction mitigation would be implemented for any alternative selected for construction. Activities requiring mitigation measures for this project would include demolition of existing surfaces and structures, clearing and grading, dewatering, concrete work, and in-water and over-water construction associated with construction of stations, an Operations Center, traction power substations, utility relocation, columns, guideway, bridges, and columns.

Stations, Operations Center, and Traction Power Substations

Construction methods for stations, the Operations Center, and Traction Power Substations would be similar for each segment. Refer to Table 4.17-14 for BMPs that would be applied to demolition activities and construction of these facilities in each segment.

Temporary Erosion and Sedimentation Control (TESC) measures would be implemented during construction for all construction activities associated with each of the alternatives. Ecology has indicated that the Green Line may be required to obtain an individual NPDES Construction Stormwater Permit. That permit would require a Stormwater Pollution Prevention Plan (SWPPP) for Construction Activities. The SWPPP would include Temporary Erosion and Sedimentation Control (TESC) plan drawings and narrative and a plan for control of pollutants other than sediment (e.g., pH, oil and grease). The SWPPP would include the following 12 elements as required by the Ecology Stormwater Manual:

- **Mark Clearing Limits** – Clearing limits would prevent disturbance of non-construction areas, and limit exposed soils. Where possible, vegetated buffer zones (other than sensitive area, wetland, and stream buffers) would be used to filter unconcentrated construction runoff.
- **Establish Construction Access** – Stabilization of construction entrances with quarry spalls (or existing pavement) would reduce mud tracking onto streets. Wheel washes will be used if necessary.
- **Control Flow Rates** – This element does not apply, since flow controls are not required for discharges to storm sewers, Lake Union, or marine waters.
- **Install Sediment Controls** – Filter fabric/silt fences at the downstream site perimeter would prevent migration of sediment from the site. Temporary sedimentation ponds would also be used to settle sediment from construction runoff, and if necessary, hold construction runoff for additional treatment or land application to reduce turbidity. Construction stormwater chemical treatment or filtration may be used to reduce turbidity in the site discharge.
- **Stabilize Soils** – Exposed areas would be covered with mulch or temporarily seeded. Polyacrylamide (PAM) may also be used as a soil stabilization measure. Surface roughening and gradient terraces would be used to reduce flow velocity over exposed soils.
- **Protect Slopes** – Interceptor ditches, dikes, and pipe slope drains would prevent water from flowing over slopes, directing runoff to sediment traps and ponds. Run-off from upslope areas would be diverted around construction sites.
- **Protect Drain Inlets** – Catch basin filter inserts would be used to protect inlets.
- **Stabilize Channels and Outlets** – Temporary drainage channels would be stabilized with geotextiles, grass, or rock lining.
- **Control Pollutants** – Water would be applied to control dust or exposed soils that are dry enough to be transported by wind. Precast concrete would be used for guideway columns where practicable and specialized concrete handling would minimize potential pH impacts to receiving

water bodies. Concrete washout would occur only in designated areas and in accordance with all permit and regulatory requirements. Appropriate on-site storage would be provided for fuels and chemicals. Fueling and equipment maintenance would be restricted to a designated staging area with an impermeable surface, spill containment features, and a spill clean-up kit. Appropriate disposal facilities would be provided for wastes generated during construction.

The Seattle Stormwater Grading and Drainage Code requires a Spill Prevention and Control program that includes the following:

- Any discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, is prohibited.
- All oil, fuel, or chemical storage tanks shall be diked and located on impervious surfaces so as to prevent spills from escaping into surface waters or ground waters of the state.
- All flows of dewatering water discharged to the storm line shall be measured. A record of turbid water discharges shall be kept containing the following information: date, flow rate of discharge, time period of discharge.
- In the event of a discharge of oil, fuel or chemicals into state waters, or onto land with a potential for entry into state waters, containment and clean-up efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Clean-up shall include proper disposal of any spilled material and used clean-up materials.
- No emulsifiers or dispersants are to be used in waters of the state.
- **Control Dewatering** – Dewatering water from foundations, vaults, and utility trenches would be tested before discharge. If dewatering water were turbid, it would be routed through a sedimentation pond for pre-treatment before discharge to sewer system or infiltration. Other treatment and disposal options are available such as chemical flocculation. Infiltration will only be used if in accordance with Ecology groundwater discharge standards. If Ecology standards of discharge to groundwater were not met, infiltration would not be used. Contaminated dewatering could be transported off-site for proper disposal, on-site chemical or other treatment, or discharge to sanitary sewer after approval is granted by the local sewer district.

Clean, non-turbid water, such as well-point groundwater, could be discharged into the storm system, or receiving waters, provided the discharge meets regulatory standards and would not cause flooding or erosion. Because none of the stations are proposed to have below ground levels, the foundation excavations would be fairly shallow and would not be expected to use well-point dewatering methods. However, if well-point dewatering were used, Ecology recommends limiting discharge to receiving waters to 10 percent of flow rate of receiving water.

Pursuant to the City of Seattle guidelines, flow control rates would be required for construction dewatering. Any continuous discharge is limited to the specified flow rates from the new impervious area per the Stormwater Grading and Drainage Code. No discharge is permitted during heavy rainfall.

Turbid water that exceeds safety standards or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam would be handled separately from stormwater and in accordance with applicable regulatory requirements.

- **Maintain Best Management Practices (BMPs)** – BMPs would be inspected weekly and after all precipitation of 0.5 inches or more in a 24-hour period. BMPs would be repaired if damaged.

- **Manage the Project** – A contractor erosion and spill control lead would be designated to ensure that the SWPPP is implemented. If inspections and monitoring reveal actual or potential discharge of sediment or pollutants, the SWPPP would be updated as necessary.

The NPDES Permit will require that construction activities do not cause exceedances of Washington State surface water quality standards, and the permit will contain enforcement mechanisms. Water quality monitoring would be performed if required by the construction stormwater permit or any other applicable approvals, licenses, or permits. Refer to Section 4.14.2.2 Washington State Statutes and Regulations for discussion of recently proposed revised State Surface Water Quality Standards.

Utility Relocation, Columns, and Guideway

Construction mitigation methods for utility relocation, columns, and guideway would be very similar to methods used for the stations, Operations Center, and traction power substations. Refer to Table 4.14-5 for BMPs that would be applied to these activities.

Bridges and Columns

Ballard Crossing

All bridge types would require column foundations consisting of drilled shafts, driven piles, or large-diameter pipe piles. If piles were to be driven into the Ship Canal, then filter sheeting could be used to isolate sediments disturbed by the pile driving process from infiltrating the surrounding water. Piles could be driven using a crane supported on a temporary work trestle or on a barge. Temporary steel casing could be used to isolate the shaft drilling operation from surrounding water. A cofferdam could be constructed using temporary steel sheet piles driven into the ship canal bottom. It could be dewatered and sealed with concrete to allow construction of the cast-in-place pile cap or shaft cap.

Another potential foundation construction method would use precast concrete panels, which may be lowered and locked together in place below the water surface, to form a cofferdam for pile driving and permanent cast-in-place pile caps. These walls would become a permanent part of the finished caps. In another potential foundation construction method, barges could be floated near foundation construction zones and sunk to the bottom to seal off the sediments surrounding construction of the piles, drilled shafts, and pile or shaft caps. The barges would be dewatered and floated away after completion and curing of the pile caps.

A temporary work trestle could also be constructed using wood or steel piling with a wood deck to support heavy cranes used during construction of the bridge columns and superstructure. Temporary pilings would likely be driven from a barge-mounted crane to sufficient depth to allow the work trestle to support all construction loads.

In addition to deep foundations (footings founded at the bed of the Ship Canal) and cofferdam construction, waterline footings could be recommended as an alternative for consideration (Figure 4.17-1). The bottom of a waterline footing is typically set one-foot minimum below the mean low water line, with a precast template (liner) at the bottom of the footing, so that it can be constructed without the use of cofferdams. This system could minimize environmental impacts to the waterway. For example, it requires no excavation and disposal of materials for construction, and it could allow for more rapid construction than typical cofferdam construction. For columns on land, the top of the footing would be set two feet minimum below the ground surface. (Some capping or excavation may be required by Ecology to address contaminated sediments prior to installation of driven piles.)

If the foundation construction method chosen involves dewatering the construction area, the water would be pumped to a pond or tank for appropriate treatment and disposal. The collected water would be tested for adherence to State water quality standards. If permitted, uncontaminated water could be discharged directly to the sanitary sewer system, in compliance with applicable regulatory requirements. Alternatively, water meeting the water quality standards could be returned to the Ship Canal. Contaminated water would be shipped off-site for proper disposal in a hazardous waste treatment facility. The specific construction protocols and thresholds for collected stormwater and dewatering would be described in the approved Construction Stormwater Control Plan.

The type of mitigation method(s) selected for in-water construction of bridge columns would be dependant on the construction method used. All of the methods mentioned are similarly effective and are designed to meet water quality standards. For a summary of BMPs that could be applied to reduce or avoid impacts of bridge construction, refer to Table 4.17-15.

Ship Canal Sediments

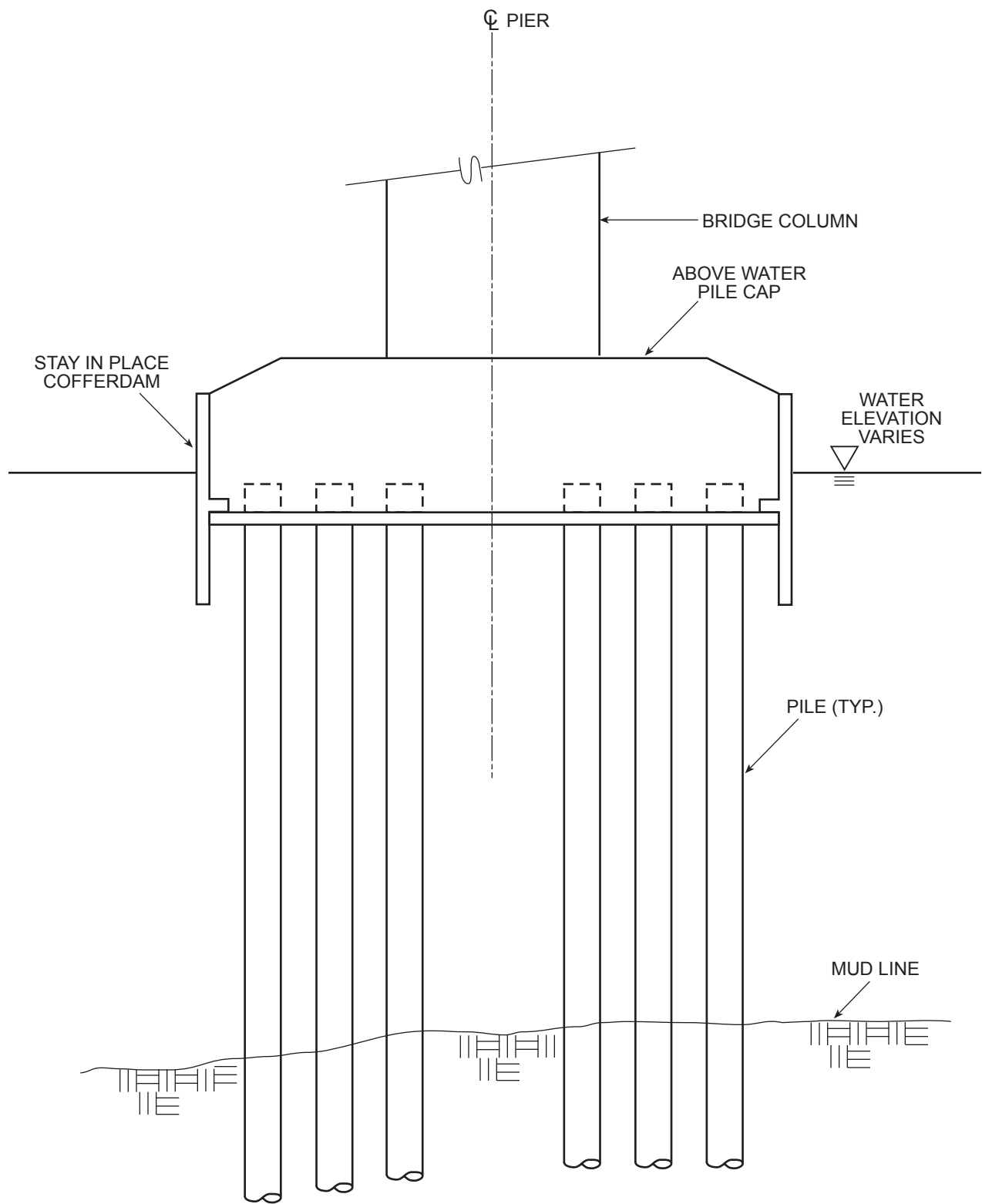
The bed of the Lake Union Ship Canal contains areas of contaminated sediments that may be encountered during construction of column foundations and footings. Contaminated sediments that could be disturbed as a result of construction activities would be mitigated using the same BMPs that are used to isolate and contain uncontaminated sediment from surrounding water.

Designation of sediments as solid or dangerous waste would be completed in accordance with Washington State Dangerous Waste Regulations (WAC 173-303). Pre-construction sampling would identify the general nature of the sediment chemical contaminants to allow for project design. Additional sediment sampling would be completed following sediment excavation to determine the sediment's specific regulatory status to allow for a final determination of disposal requirements. Large debris such as chunks of concrete, treated or un-treated piling, and metal objects should be segregated and stockpiled separately.

Classification of sediment excavated for Green Line bridge supports within the Ship Canal would vary with location of final design. Excavated sediment would be stockpiled using appropriate BMPs until sampling, analysis, and classification are complete. Stockpiled sediments that meet any hazardous waste criteria would be removed from the site within 30 days to a permitted facility.

Based on available sediment chemistry, data indicate that some sediment may be classified as hazardous waste under waste codes D004 (Arsenic), D009 (Mercury), and D008 (Lead). Sediment could additionally be classified with Washington waste codes (for persistent) WP01, WP02, WP03 for HOCs and/or PAHs; and possibly Washington waste codes (for toxicity) WT01 or WT02, for tributyltins (refer to Tables 4.1-1 and 4.14-2). If analytical results for sediment exceed dangerous waste threshold concentrations, the sediment would be managed as dangerous waste in accordance with WAC 173-303-200. Sediment that is classified as dangerous waste would be disposed of at a Subtitle C landfill.

If sediment does not contain leachable constituents or other Underlying Hazardous Constituents at concentrations greater than ten times the Universal Treatment Standards (UTS) (40 CFR 268.48), then the sediment may be disposed of at a Subtitle C landfill without further treatment. If the sediment does contain leachable constituents, or other Underlying Hazardous Constituents, at concentrations greater than ten times the UTS, then the material may require treatment prior to disposal. The final decision of the need for treatment would be determined by the disposal facility according to their permit requirements.



NOT TO SCALE

Source: Jacobs Civil Inc.



**Figure 4.17-1
Typical Waterline
Pile Cap Diagram**

Transportation of waste materials including dangerous waste would be according to Specification Section 02210 3.05, 49 CFR Part 172, WAC 173-303, DOT protocols and regulations, and/or other applicable federal, state, and local regulations.

Contaminated sediments would be disposed of at any of several facilities located in south central Washington or northern Oregon. Currently, several facilities have obtained approval to receive sediments containing free liquids, in accordance with their permit requirements thereby eliminating the need for on-site sediment dewatering.

Stockpiled sediment that does not exceed the dangerous waste concentration (WAC 173-303-090) or landfill requirements for metals or other constituents would be disposed of at a Subtitle D landfill.

Sediments may also be characterized in accordance with the Washington State Dredged Material Management Program (DMMP) protocols. This characterization may determine that all or part of the dredged sediments are non-contaminated and suitable for open-water disposal per DMMP guidelines. The DMMP represents a coordinated multi-agency approach to management of dredged materials in the State of Washington. The cooperating agencies include the U.S. Army Corps of Engineers – Seattle District, U.S. Environmental Protection Agency – Region 10, and the Washington Departments of Ecology and Natural Resources. By statutory requirement, the Washington State Department of Natural Resources (“DNR”), “provides, manages and monitors aquatic land disposal sites on state-owned aquatic lands for material dredged from rivers, harbors, and shipping lands.” DNR is responsible for management and environmental monitoring of eight unconfined open-water dredged material disposal sites around Puget Sound.

DNR, in consultation with other DMMP agencies, is responsible for conducting regularly scheduled environmental monitoring events at its open water disposal sites to verify that DMMP management guidelines are adequately protecting the environment against unacceptable adverse impacts. These monitoring events confirm whether deposited materials remain within the disposal site boundaries, the cleanliness of the materials disposed at the site, and the effect of dredged materials on local aquatic life.

Duwamish Waterway Bridge

Similar mitigation methods for over-water work and in-water work associated with construction of the temporary trestle would be used for either of the Duwamish Waterway crossing Alternatives 6.1 (West Seattle Bridge) or 6.2 (New Bridge). Construction techniques used to build a concrete box girder, segmental, balanced cantilever bridge minimizes impacts to the water below the bridge. Formwork and/or a work platform would prevent any spills from concrete work from falling into the Duwamish.

4.17.16 Plants and Animals

Construction of the Green Line has the potential to alter or remove existing habitat at several locations along the route. This section focuses on potential short-term impacts and changes resulting from construction of alternative Green Line alignments. Section 4.15, Plants and Animals, analyzes longer-term operational impacts and mitigation, including impacts related to the loss of habitat and removal of vegetation. Section 4.15, Plants and Animals, provides greater detail regarding habitat types and species of fish, animals, and vegetation potentially affected by alternative Green Line alignments. The determination of potential impacts of the various alternatives is based upon life history analysis, habitat requirements, literature review, agency consultation, Priority Habitats and Species (PHS) data from WDFW, and field reconnaissance studies.

4.17.16.1 Impacts to Fish and Wildlife

Impacts of construction to fish and wildlife could occur at specific locations where the Green Line intersects habitat supporting fish and wildlife. These locations are primarily the Lake Washington Ship Canal, Duwamish River East Waterway, and other segments where increased human activity and noise from construction could potentially affect plants and animals. At the Ship Canal, construction of the Ballard Crossing would involve in-water work to provide new support columns. At the Duwamish River crossing, construction would include retrofitting and reinforcement of the existing West Seattle Bridge piers, which would involve work from barges or in-water supports for a temporary trestle across the East Duwamish Waterway.

Potential bridge construction approaches for the Ballard Crossing are identified in Section 3.7.7 and in Section 3.9.10. Various types of bridge construction (i.e., box girder, cable-stayed, arch) may have different impacts on fish, wildlife, and vegetation, depending on the number and nature of temporary and permanent in-water support structures. Alternatives 2.1.1 and 2.1.2 would likely have fewer support columns within the Ship Canal than Alternative 2.2. SMP has identified a modified box girder bridge in the Preferred Alternative for the Duwamish Crossing. For the Ballard Crossing, each of the nine to eleven support columns will be up to approximately 12 feet in diameter, thereby covering up to approximately 1,200 square feet of bottom area. As described below, the footings for each column will be up to approximately 48 by 48 feet square, and will be constructed below the mud line and covered with clean fill up to the mud line. These long-term impacts are discussed in Section 4.15, Plants and Animals.

Potential direct impacts to fish from construction could also include human disturbance and noise during construction and temporary, localized turbidity in the Ship Canal and the Duwamish East Waterway. Applicable fish windows would be observed and appropriate construction techniques and best management practices would be employed to avoid, minimize, and offset these impacts. Potential indirect impacts may include temporary changes to invertebrate resources in the area of sediment disruption. Mitigations for these potential construction impacts are identified below and in Chapter 5, Mitigation Program. Along these and other segments, stormwater would be managed as described in Section 4.17.15.

Construction activities have the potential to affect species listed under the Endangered Species Act (ESA). Therefore, as discussed in Section 4.15, Chinook salmon and individual bull trout occur in the Ship Canal and the Duwamish River, and some bald eagles occur within the project area. SMP is coordinating with the USCG in the preparation of a Biological Evaluation (BE) included in Appendix RR. The BE indicates construction of the Green Line may affect, but is not likely to adversely affect Chinook salmon and bull trout, affect wintering bald eagles, will not jeopardize the existence of coho salmon, and, if listed, is not likely to adversely affect coho salmon.

In-water construction activities at the Ship Canal and the Duwamish East Waterway also have the potential to affect tribal fishing access. SMP is assisting USCG in initiating government-to-government consultation with affected tribes, including the Muckleshoot Tribe, for purposes of identifying potential effects of Green Line construction on treaty fishing rights. SMP, in cooperation with the tribes, is currently developing information on tribal fishing patterns and activities. This information will enable SMP to tailor construction in a way that avoids or minimizes impacts to treaty fishing rights.

Segments 1 and 2: Ballard and Interbay/Magnolia Segments

Ship Canal. Construction of the Ballard Crossing would involve in-water work to provide new support columns for a bridge. In the Ship Canal, juvenile salmonids are likely to avoid the immediate vicinity of the construction activity during periods that involve disruption of the bottom and the placement or

movement of large objects within the water. Construction impacts to juvenile salmon could be avoided or minimized by limiting in-water construction to a period established by appropriate agencies to avoid impacts from construction to fish.

Support columns for the bridge would include up to eleven approach columns. Main span support columns would be either drilled shaft or pile-supported footings within the Ship Canal sediment. Construction of driven shafts or piles and footings for the approach columns would be conducted by first placing a sheet pile cofferdam at the column location. The approximately 48 by 48 foot area within the cofferdam would be dewatered. Driving of piles or drilling of shaft foundations would occur within the dewatered area.

Approach support columns would also be constructed on either drilled shafts or driven piles. The approach support columns would rest directly on the drilled shafts if that technique is used. The approach support columns would rest on pile caps buried within the sediment if a driven pile technique is used. Both the main span and approach support columns for the Ship Canal bridge are expected to be solid structures, most likely concrete (to be determined by final design), within the water column above the piles.

Driving piles or placing or removing cofferdams could produce temporary localized increases in turbidity, primarily near the bottom at the cofferdam location. Appropriate construction techniques and best management practices (BMPs) will be employed to minimize resuspension of sediments. See Section 4.17.15 for additional information on BMPs. Fish exposures to resuspended sediments would, therefore, be minimized and no significant impacts would be expected. Impacts to fish would be minimized by keeping in-water columns at least 100 feet from the shoreline. Shoreline impacts would be avoided by keeping in-water columns at least 50 feet from the shore, since existing biological production at the potential support column locations is limited by the physical and chemical conditions of the column locations.

Construction of the Ballard Crossing would use either barges or temporary trestles, or both as work platforms. Operation and moorage of barges and other vessels within the Ship Canal is an existing routine commercial use of this area. Barges would provide temporary shading impacts during the time they are in place. However, the area shaded primarily supports invasive exotic aquatic vegetation during the summer and autumn. Minor actions such as movement of vessels is not likely to disturb the activity of fish, except directly adjacent to the activity.

Temporary trestles could be connected to the shoreline in an area currently having numerous shoreline columns and docks. Trestles supported by 36 in-water piles would be constructed on both the north and south sides of the Ship Canal. Piles would be closed end, steel piles 30-inches in diameter, placed on 28-foot centers. The piles would support H- beam bridge members to be covered with a wood mat. The wood mat would provide a deck about 32-feet wide and up to 12 inches thick. The north trestle would be 115 feet long and the south trestle 300 feet long and would not extend into the navigation channel. The temporary trestles would shade a narrow portion of the shallow water habitat extending out from the shoreline parallel with the Ballard Bridge. However, this shaded area is likely to be avoided by juvenile salmon that would likely migrate around the perimeter of the trestles during the time they are in place. The temporary trestle could also potentially add to the shoreline habitat for small mouth bass and lead to some increased predation on juvenile salmonids during the time they are present. The temporary trestles could be in place for up to two years. Excavation for the support column footings would be conducted by dredging the sediment from within the cofferdams. Excavated material would be placed in Baker tanks on barges or a trestle. The Baker tanks would be transferred to shore for disposal of the excavated sediment at an approved disposal facility in accordance with applicable regulatory requirements. Water from the Baker tanks may be pumped into a treatment facility and then discharged back into the waterway.

or into the sanitary sewer system on land for further treatment as appropriate. If containment barges are used, the barge would have side boards of 5 feet in height to contain excavated material, which would be taken to an approved treatment/disposal facility in accordance with applicable regulatory requirements to avoid impacts to fish or aquatic habitat.

Sediment at the Ballard crossing location has been contaminated by industrial activities that have occurred along the shorelines and in shoreline waters for approximately 85 years. Construction methods will minimize disturbance of bottom sediments, which may contain contaminants. The SMP and its DBOM contractor will develop protocols for evaluation, handling, and treatment/disposal of any contaminated sediments in the Ship Canal prior to initiation of in-water work. As necessary for construction, contaminated sediment will be excavated and transported to an approved upland treatment or disposal facility, and will not be allowed to reenter waters of the U.S. or state to avoid fish exposures to contaminants.

As described above, piles to support footings for the bridge support columns would be driven within cofferdams. Piles driven in the dry within cofferdams would have no noise impact to the surrounding water. The construction impact of driving piles to support the temporary work trestles directly in the water of the Ship Canal would be production of sound pressure within the water column. Hammer-type pile driving can produce sound pressure levels of about 190 dB (re: 1 μ Pa) within the water column at a distance of about 150 feet in deep water (WSDOT 2003). In shallow water, sound pressure attenuates more quickly than in deep water. Pile driving in the Ship Canal would occur in areas with depths in the range of 12 to 24 feet. Sound pressures levels of 180 dB can damage the auditory hair cells of fish. A safe level for fish may be about 150 dB. Vibratory driving of piles reduces sound pressure levels 10 to 20 dB.

The potential noise impact from driving piles would be avoided or minimized by using appropriate construction methods. Sound pressure levels could be reduced by driving piles within dewatered cofferdams, by surrounding a pile with bubble screens, or using a vibratory hammer. Driving piles within dewatered cofferdams provides an air cushion surrounding the pile driving area avoiding transmission of the potentially damaging energy to the surrounding water and fish. Bubble curtains surrounding each driven pile can also reduce the transmission of energy to the surrounding water, avoiding levels that could potentially be injurious to fish. In the low current velocity of the Ship Canal, bubble curtains are likely to be effective in reducing energy transmission below levels that would injure hearing in fish or produce tissue damage in swim bladders. Use of a vibratory hammer reduces sound pressure levels to 10 to 20 dB, well below sound pressures thought to harm fish.

Following footing excavation a concrete sheet pile seal would be placed by tremie. Dewatering would then occur. Dewatering discharges would be directed to Baker tanks or other filtering devices and handled according to dewatering protocols described in Section 4.17.15. Drilling or pile driving operations would take place after dewatering.

Footings for the bridge support columns would be placed either on piles or drilled shafts constructed within cofferdams. The footings for the bridge support columns would be constructed below the mud line of the existing Ship Canal. About two feet of new clean material would be placed over the top of the footing to restore the original mud line elevation. Construction would occur within cofferdams placed at each support pier location. Placement and removal of the cofferdam structures would produce localized temporary turbidity at the cofferdam location. To minimize turbidity and any associated impacts to fish, cofferdams would be removed or cut off at or below the mudline upon completion of construction.

The support columns would most likely be solid concrete structures within the water column from the footing surface to above the water surface, or steel piers may be installed. The DBOM contractor will

determine final construction methods to form the piers. The typical method of constructing piers would use cast-in-place concrete. Cast-in-place concrete piers use reinforcing steel cages tied above reinforcements extending from the pile caps. The reinforcing cage would extend up through the entire height of the pier and end with additional apparatus to attach box girders at its top. Temporary wood or steel forms would be fitted around the reinforcing cage and secured. Concrete would be poured into the forms in multiple lifts. Concrete placement would typically be by pump and using a 5- or 6-inch hose for delivery to the placement area. Concrete would be poured through a small-diameter flexible hose called a tremie. The mouth of the tremie hose would be placed at the bottom of the form to prevent splashing or accidental spillage of concrete. At no time would concrete or concrete by-products be allowed to discharge to surface waters. All concrete would then be allowed to cure before the forms are removed and any beams or girders may be installed. No wet concrete would be allowed to contact surface waters, thus fish exposure would be avoided.

Some support columns (see Appendix B) may be constructed where underwater obstructions exist. The existing ship repair facility on the south side of the Ship Canal has an underwater rail (ship ways) for moving vessels into the dry dock. The ship ways and a timber pier may need to be removed for construction of support columns.

Limited quantities of petroleum, concrete, paint or other toxic materials may be used at construction sites. Quantities of these materials used over water would generally be small (gallons to several hundred gallons). However, there is the potential for accidental spills or releases to occur during construction of a new support structure across the Ship Canal. BMPs for construction activities would be followed to minimize the potential for accidental spills or releases of construction materials from over water construction sites. The BMP approach follows current Ecology and City of Seattle stormwater management manuals to identify appropriate control measures for various construction activities that may be used by the contractor. See Section 4.17.15 for additional information on BMPs.

Noise associated with construction of the bridge and guideway at the Ship Canal is not likely to affect birds or other wildlife that may be present. Existing noise levels are in the range of 64 to 72 dBA, with maximums up to 99 dBA (see Section 4.7, Noise and Vibration). Construction activities would be in the range of 65 to 90 dBA at 100 feet from the activity, with the sound level depending on the type of equipment being used.

Resident bald eagles may forage at the Ship Canal site. However, construction activities along this segment will occur within areas where considerable human activity and vessel movement continuously occurs with existing conditions. Local bald eagles are likely habituated to human activities. As such, short-term noise and human disturbance associated with construction activities would not affect bald eagle behavior. PHS data do not indicate any winter concentration areas, roost sites, or nest sites within one mile of the project area.

Temporary lighting may be necessary for nighttime construction of Ship Canal bridge structures. This temporary lighting would have the potential to affect fish behavior by increasing ambient nighttime light levels in the immediate vicinity of the lighting. Temporary lighting impacts would be minimized by shielding light sources and by directing them toward work areas to reduce lighting of water areas. During construction, lighting would be directed away from water areas and shielded to the extent practicable to minimize lighting of water adjacent to the work areas.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Removal of street trees during construction (see Section 4.5, Visual Quality and Aesthetic Resources) has the potential to negatively affect birds in the urban area. Most birds supported by these street trees are

species highly adapted to the urban environment, commonly nesting and foraging in man-made habitats. Habitat supporting native species requires substantial areas of tree coverage and density of trees. Donnelly (2002) found bird habitat quality to be at least as important as habitat quantity and pattern. Larger habitat reserves contained richer communities, greater habitat diversity, and a greater abundance of birds than smaller reserves. Native bird species tend to be present and more abundant in habitat reserves greater than 104 acres, surrounded by less than 40 percent urban land cover, and containing little exotic vegetation. These conditions are not provided by any of the vegetated areas potentially disturbed by the Green Line in this or any other segment.

In areas where street trees would be removed for Green Line construction, birds supported by these trees would be displaced. Since bird species supported by these street trees are highly adapted to the urban environment, they would relocate to trees on other nearby streets or vegetated areas. Overall reductions in the number of birds present in the vicinity of the Green Line would not be expected as a result of the project.

Queen Anne Greenbelt/Kinnear Park. The Green Line alignment passes near the Queen Anne Greenbelt/Kinnear Park area, which contains a variety of vegetation including some potential perch trees and wintering bald eagles. Terrestrial habitat retaining natural characteristics along the corridor at the Howe Station area on the Queen Anne hillside (Interbay Segment) would not be altered by construction of any of the alternatives. Construction of either alternative at the Howe Street station sites is not likely to affect wildlife using the natural vegetation on the nearby Queen Anne hillside. Potential perch trees for bald eagles are sufficiently far from the construction location in areas of intense human activity and local bald eagles are likely sufficiently habituated to human activities, that short-term increases in noise and human disturbance associated with construction activities are unlikely to affect bald eagle behavior.

Noise from construction would be within the range of existing average noise levels from the roads adjacent to the habitat are in the likely to be in the range of 70 to 74 dBA, with maximums up to 94 dBA (see Section 4.7, Noise and Vibration). Construction activities would be in the range of 65 to 90 dBA within 100 feet of the activity, with the sound level depending on the type of equipment being used. Construction activities would be several hundred feet from the habitat. No impacts to birds or mammals are anticipated because of the distance of construction from natural habitat together with the high levels of ambient noise at the construction sites.

Segment 4: Downtown/Pioneer Square Segment

No habitat supporting fish and wildlife, other than small numbers of street trees occurs along the Downtown Segment of the Green Line alternative alignments. In areas where street trees would be removed for Green Line construction, birds supported by these trees would be displaced. Since bird species supported by these street trees are highly adapted to the urban environment, they would relocate to trees on other nearby streets or vegetated areas. All alignment alternatives (4.1.1, 4.1.2, 4.2, 4.3, and 4.4) could affect the large Sequoia tree on Stewart Street between Third Avenue and Fourth Avenue, which may be able to be protected, but may be trimmed or replaced.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

No habitat supporting fish or wildlife, other than small numbers of scattered street trees occurs along the SODO Segment of the Green Line. In areas where street trees would be removed for Green Line construction, birds supported by these trees would be displaced. Since bird species supported by these street trees are highly adapted to the urban environment, they would relocate to trees on other nearby streets or vegetated areas.

Segment 6: West Seattle Segment

Duwamish River. Each of the alternatives for crossing the Duwamish River would have very similar impacts to the aquatic habitat. No new, permanent in-water structures would be constructed at the Duwamish River crossing with the alternatives since all new, permanent structures would span the East and West Waterways or would be constructed on the existing West Seattle Bridge. However some temporary in-water or over-water structures could be placed at the Duwamish East Waterway.

Alternative 6.2 would be a new bridge between the West Seattle Bridge that would span the East and West Waterways and would have no in-water structures during construction. Alternatives 6.1.1 and 6.1.2 would be over the West Seattle Bridge and have no construction impacts on the Duwamish West Waterway. Construction impacts could occur in the East Waterway resulting from construction and use of either a trestle or segmented barge placed over a portion of the waterway. The temporary structure would be used to support structural strengthening of the four West Seattle Bridge support columns located within the East Waterway, as discussed below.

Noise associated with construction of the Duwamish River crossing is not likely to affect birds or other wildlife that may be present. Existing noise levels are in the range of 64 to 72 dBA, with maximums up to 99 dBA (see Section 4.7, Noise and Vibration). Construction activities would be in the range of 65 to 90 dBA at 100 feet from the activity, with the sound level depending on the type of equipment being used.

Bald eagles forage within the Duwamish River area of the project where project construction activities would occur. However, construction activities along this segment will occur within areas where considerable human activity and vessel movement continuously occurs with existing conditions. Local bald eagles are likely habituated to human activities. As such, short-term noise and human disturbance associated with construction activities would not affect bald eagle behavior. Any disturbance to foraging behavior would be minor and temporary. The proposed project would have no direct impact on nesting or wintering bald eagles or their prey base. PHS data do not indicate any winter concentration areas, roost sites, or nest sites within 1 mile of the project area. No nesting or roost trees would be affected, and construction of the crossing is not likely to substantially affect the eagles' aquatic prey base.

Duwamish River East Waterway. Constructing the Green Line on top of the West Seattle Bridge would require the bridge pile caps on which the roadway rests to be retrofitted and strengthened for the non-box girder section of the bridge. This would include two sets of two West Seattle Bridge support piers located in the East Waterway (Piers 25 and 26) requiring work over the East Waterway. Construction would be dowel and rebar installation with forming and concrete placement around the existing piers above the water. No permanent structures would be placed in the water. However, construction would require some form of temporary platform in the East Waterway. Access to the work area of the East Waterway under the West Seattle Bridge is obstructed on the north by the low-level Spokane Street Bridge and south by the low-level railroad bridge. The area is also sufficiently shallow to prevent navigation by most work vessels (-6 to -12 ft MLLW). The close spacing of the piers supporting the Spokane Street and railroad bridges together with their low elevation limits navigation within the work area to small skiffs. Thus, it is not possible to bring a construction barge in to support work under the West Seattle Bridge within the East Waterway.

There are two potential construction access methods available for work over the East Waterway. The first potential construction method would be to transport a flexi-float/sectional barge or similar barge over land by truck to the site and use a crane to place the sections in the water. The sections would then be fastened together to form a stable work platform. Mooring lines would be attached to adjacent land and secured deadman anchors, or other fixed structures. A platform would be constructed on land to reach to support

a crane to move materials, etc to the barge. Another platform would be attached to the pier columns above high water. Some temporary roadway work may be required to access the shoreline area under the West Seattle Bridge. Following completion of the construction, the sectional barge and approach road would be removed and the area restored to the original condition.

The second potential East Waterway construction method would provide a temporary trestle to access the retrofit work. The trestle would include 18 pairs of 30-inch diameter piles located on 30-foot centers over about two-thirds of the approximately 250-foot width of the channel. The piles would support H- beam bridge members to be covered with a wood mat. The mat would provide a deck about 24-feet wide and up to 12 inches thick. The trestle would not span the entire width of the waterway at any time, so navigation through the work area would be maintained for small craft. After the trestle was placed at each pile area, work platforms would be attached to the West Seattle Bridge piers to support retrofit work. Following completion of the construction, the trestle would be removed including all piles and the area restored to the original condition.

The temporary placement of either a sectional barge or pile-supported trestle in the Duwamish East Waterway would produce temporary shading effects under the West Seattle Bridge. A bed of bull kelp (*Nereocystis luetkeana*) was observed growing in this area in 2000 (Memo to George Blomberg, Port of Seattle by Don Weitkamp, Parametrix, Inc.). However, this bull kelp bed was not present during a site inspection by boat in May 2003 or from shore in June 2003 (Don Weitkamp).

Driving piles or placing or removing cofferdams could produce temporary localized increases in turbidity. Appropriate construction techniques and best management practices (BMPs) will be employed to minimize resuspension of sediments. See Section 4.17.15 for additional information on BMPs. Fish exposures to resuspended sediments would, therefore, be minimized and no significant impacts would be expected. The potential noise impact from driving piles would be avoided or minimized by using appropriate construction methods, such as driving piles within dewatered cofferdams, by surrounding a pile with bubble screens, or use of a vibratory hammer.

Limited quantities of petroleum, concrete, paint or other toxic materials may be used at construction sites. Quantities of these materials used over water would generally be small (gallons to several hundred gallons). However, because there is the potential for accidental spills or releases to occur during construction. BMPs for construction activities would be followed to minimize the potential for accidental spills or releases of construction materials from over water construction sites. The BMP approach follows current Ecology and City of Seattle stormwater management manuals to identify appropriate control measures for various construction activities that may be used by the contractor. See Section 4.17.15 for additional information on BMPs.

Potential temporary lighting impacts from nighttime construction would be minimized by shielding light sources and by directing them toward work areas to reduce lighting of water areas and potential alteration of fish behavior. During construction, lighting would be directed away from water areas and shielded to the extent practicable to minimize lighting of water adjacent to the work areas.

Duwamish River West Waterway. Construction of the Green Line either above or adjacent to the West Seattle Bridge could involve some work from barges in the Duwamish River West Waterway. Barge-mounted cranes would be used to lift materials to box girder area. Barges would move as necessary to accommodate navigation. Workers and smaller materials would access the platforms from the West Seattle Bridge above the work area. Operation and moorage of barges and other vessels within the Duwamish West Waterway is an existing routine commercial use of this area. Because the highly used navigation channel spans most of the river width under at the West Seattle Bridge location, work barges

would not be anchored in place for prolonged periods. The East Waterway location is not accessible to large barges between the Spokane Street Bridge and the railroad bridge south of the West Seattle Bridge.

Pigeon Point Greenbelt. Noise together with the human activity of construction in the Pigeon Point area has the potential to disturb birds and wildlife. Existing average noise levels from the West Seattle Bridge adjacent to the habitat are in the range of 70 to 74 dBA, with maximums up to 94 dBA (see Section 4.7, Noise and Vibration). Construction activities would be in the range of 65 to 90 dBA within 100 feet of the activity, with the sound level depending on the type of equipment being used. No impacts to birds and wildlife due to construction noise are anticipated because construction noise levels would be within the range of ambient noise levels.

Longfellow Creek. The alternatives for the Longfellow Creek area evaluated in this Final EIS have been revised following the Draft EIS analysis to avoid impacts that might have occurred with one or more of the original alternatives. The Preferred Alternative would avoid construction impacts to Longfellow Creek and its riparian habitat by placing the guideway and Delridge 3 station north of where the stream enters the 3,161-foot-long pipe that discharges to the Duwamish West Waterway. No alternative would cross the open channel of Longfellow Creek avoiding any direct construction impacts to the stream. Alternative 6.1.1 would cross Longfellow Creek just south of SW Andover Street downstream from where it enters a 60-inch pipe (Longfellow Creek Watershed Management Committee, 1992). The Delridge station for this alternative would have construction within the periphery of the riparian area adjacent to the culvert entrance. The crossing over the culvert section of Longfellow Creek would be approximately 70 to 75 feet above the ground with support columns near the edges of or within the periphery of the riparian corridor. Construction would be placement of precast guideway beams between support columns on either side of the culverted section of the stream with no direct construction impacts to the stream's open channel. At this location, there is natural riparian vegetation and recent landscape plantings along the western side. With Alternative 6.2 construction impacts to Longfellow Creek would be avoided because the guideway would be along SW Andover Street where Longfellow Creek is contained within the 3,161-foot-long pipe that discharges to the Duwamish River West Waterway. The Preferred Alternative 6.3(s) and other alternatives (6.2 and 6.4) also would not impact any open channel section of Longfellow Creek. None of the alternatives would involve construction within or over the open stream channel; therefore no impacts to fish are anticipated.

Noise and general construction activity has the potential to disturb birds and wildlife in the Longfellow Creek riparian corridor immediately south of SW Andover Street. Existing average noise levels from the SW Andover Street and other adjacent streets is likely in the range of 64 to 72 dBA, with maximums up to 99 dBA (see Section 4.7, Noise and Vibration). Construction activities would be in the range of 65 to 90 dBA within 100 feet of the activity, with the sound level depending on the type of equipment being used. No impacts to birds and wildlife due to construction noise are anticipated because construction noise levels would be within the range of ambient noise levels.

4.17.16.2 Impacts to Vegetation

Street trees would be trimmed, removed or replaced at various locations along the Green Line route during construction. Numbers of street trees potentially removed or trimmed during construction for operation of the Green Line are discussed in Section 4.15.2.1. No wetlands or natural vegetated areas would be affected by the preferred alternative, however other alternatives would affect vegetation at one or several locations. The Ballard crossing of the Ship Canal would be constructed in a location where no natural riparian vegetation exists and aquatic vegetation habitat is limited to invasive exotic species. The Duwamish River crossing would be constructed above the existing West Seattle Bridge minimizing impacts to the small amount of riparian habitat adjacent to the East and West Waterways of the Duwamish River. The Preferred Alternative would avoid the Pigeon Point vegetation, while construction

of Alternative 6.2 would remove existing forest vegetation from the north end of the Duwamish Green Belt. The Preferred Alternative would avoid the riparian vegetation at Longfellow Creek, while Alternative 6.1 would construct the Delridge station on the edge of the riparian area and one support column within the riparian area.

Segments 1 and 2: Ballard and Interbay/Magnolia Segments

Ship Canal. The Ship Canal is a constructed habitat that has been degraded by major modification to support intense commercial use. No natural riparian vegetation exists immediately adjacent to the Ship Canal. Planted vegetation east of the Ballard Bridge on the north shore might be removed by construction of Alternative 1.2 depending on final selection of the alignment. A small area of landscape vegetation is present immediately adjacent to the east side of the bridge on the Seattle Maritime Academy grounds. The vegetation might be removed during construction of East Bridge Connection Alternative 2.2 if a support column is located near the shoreline.

Barges would provide temporary shading effects during the time they are in place. Temporary trestles would shade a narrow portion of the shallow water habitat extending out from the shoreline parallel with the Ballard Bridge. However, the area that would be shaded primarily supports invasive exotic aquatic vegetation. Eurasian milfoil that grows in the shallower portions of the Ship Canal outside the navigation channel would be removed at the locations of the approach columns and main span support columns. This non-native species is commonly considered a nuisance species and major efforts have been made in the past to remove it from portions of Lake Washington and the Ship Canal.

Street Trees - Ballard and Interbay/Magnolia. See Section 4.15.2.1 for species and numbers of street trees potentially removed or trimmed for Segments 1 and 2 alternatives. With construction of Alternative 1.2 (Center of 15th) a few additional trees near the Ballard Swimming Pool could be affected depending on the final design. Construction of the Dravus 1 (16th) station alternative and platform would remove several trees near the grocery store building. The Dravus 1B (Barrett) station alternative construction would remove a few more trees than Dravus 1.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

No natural habitat vegetation would be affected by construction within Segment 3.

Street Trees - Queen Anne/Seattle Center/Belltown. See Section 4.15.2.1 for species and numbers of street trees potentially removed or trimmed for Segment 3 alternatives during construction. Some existing trees within the Seattle Center would be removed or restricted in height by the monorail with each alternative alignment through the Seattle Center. Construction of the Belltown 1 (Center-West) station alternative would remove a few mature street trees on the west side of Fifth Avenue.

Segment 4: Downtown/Pioneer Square Segment

No natural habitat vegetation would be affected by construction within Segment 4.

Street Trees - Downtown/Pioneer Square. See Section 4.15.2.1 for species and numbers of street trees potentially removed or trimmed for Segment 4 alternatives during construction. Construction of all alignment alternatives (4.1.1, 4.1.2, 4.2, 4.3, and 4.4) could affect the large Sequoia on Stewart Street between Third Avenue and Fourth Avenue.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

No natural habitat vegetation would be affected by construction within Segment 5.

Street Trees - SODO/ International District/Pioneer Square. See Section 4.15.2.1 for species and numbers of street trees potentially removed or trimmed for Segment 5 alternatives during construction.

Segment 6: West Seattle Segment

Duwamish River. The small amount of riparian vegetation at the edge of the East Waterway could be removed during construction. This vegetation consists of grasses and non-native plants in a narrow strip between the dirt parking area and the top of the shoreline.

The temporary placement of either a sectional barge or pile-supported trestle in the Duwamish East Waterway would produce temporary shading effects under the West Seattle Bridge. Construction of the reinforcement of the existing four in-water support columns would take 2-4 months per column. A bed of bull kelp (*Nereocystis luetkeana*) was observed growing in this area in 2000 (Memo to George Blomberg, Port of Seattle by Don Weitkamp, Parametrix, Inc.). This bull kelp bed was not present during a site inspection by boat in May 2003 or from shore in June 2003 (Don Weitkamp). Construction of the temporary trestle or segmented barge over a portion of the East Waterway under the West Seattle Bridge would potentially reduce photosynthesis and bull kelp distribution at this location while it is in place.

Pigeon Point Greenbelt. Construction of the Preferred Alternative would avoid impacts to the vegetation on the Pigeon Point hillside adjacent to the West Seattle Bridge. Alternative 6.1.2 would require removal of vegetation the Pigeon Point greenbelt under and adjacent to the guideway assuming all vegetation within 50 feet on either side of the Green Line alignment centerline would be removed by construction activities, an area of up to 50,000 square feet would be disturbed. Alternative 6.1.2 would place structures within the edge of the West Duwamish Greenbelt at Pigeon Point. Alternative 6.1.2 would curve southeast from the median of the West Seattle Bridge at SW Marginal Way and onto the Pigeon Point area, placing columns and other structural supports within the northwest portion of the greenbelt slope. Alternative 6.1.2 would place the guideway through about a 400-foot length of vegetation, with two or three support columns within the vegetation area (assuming spacing of 155 to 185 feet). Construction of the support columns and guideway would potentially remove all existing vegetation along the 400-foot corridor within 50 feet to either side of the centerline. Removal of this vegetation would likely be replaced with new vegetation following construction. The area of construction would not support mammals and birds that currently inhabit the construction site during construction. Following construction the vegetation would gradually reestablish providing new, but reduced habitat for birds and mammal using this location. This amount of lost vegetation would result in reduced habitat supporting several species of birds and wildlife. Alternatives 6.1.1 and 6.2 would not directly alter the greenbelt area avoiding construction impacts to the West Duwamish Green Belt and the birds and mammals it supports.

Longfellow Creek. The Preferred Alternative 6.3(s) would avoid any affect on the riparian vegetation adjacent to Longfellow Creek. Alternatives 6.2 and 6.4, and 6.4(s) also would not impact any portion of the Longfellow Creek riparian vegetation. With Alternative 6.2, construction impacts to Longfellow Creek vegetation would be avoided because the guideway would be along SW Andover Street where Longfellow Creek is contained within the 3,161-foot-long pipe that discharges to the Duwamish River West Waterway. None of the alternatives would involve construction within the open stream channel. Alternative 6.1 would pass or over the open stream channel and construct a support column within the riparian area west of Longfellow Creek.

Alternative 6.1 could potentially impact a portion of the buffer of Wetland A (see Figure 4.15-1), and Alternatives 6.4 and 6.4(s) could potentially impact Wetland B's buffer. If a guideway column is located in a wetland buffer area, mitigation could be required by the City of Seattle or Department of Ecology regulations. Since the column spacing can span distances up to 120 feet, it is expected that at most a single 12-foot diameter column would be located within these buffers. As a result, the total area of the

buffer impact for each of these alternatives would likely not exceed 115 square feet. With Alternative 6.1 constriction of the Delridge station would potentially remove a small amount of vegetation at the periphery of the riparian area adjacent to the Longfellow Creek culvert entrance immediately south of SW Andover Street. At this location, there is natural riparian vegetation and recent landscape plantings.

Street Trees. See Section 4.15.2.1 for species and numbers of street trees potentially removed or trimmed for Segment 6 alternatives during construction.

4.17.16.3 Mitigation

SMP is working with resource agencies, the City of Seattle, and other entities to develop appropriate mitigation measures for construction impacts to plants and animals. Please see Chapter 5, Mitigation Program, for additional discussion of mitigation measures to be implemented.

Segments 1 and 2: Ballard and Interbay/Magnolia

Lake Washington Ship Canal. The Ship Canal is a constructed habitat that has been degraded by chemical contamination and major modification to support intense commercial use. Existing biological production at the potential support column locations is limited by the physical and chemical conditions of the column locations. Nonetheless, mitigation could be required as part of permit conditions for lost habitat or lost habitat functions resulting from construction of new in-water structures for the Ship Canal Bridge. Mitigation for loss of approximately 1,200 square feet of substrate in the Ship Canal from placement of permanent pile foundations to support bridge columns is discussed in Section 4.15. Mitigation for minor, temporary construction impacts to degraded habitat and habitat functions are discussed in this section.

Construction impacts to fish will be minimized by adhering to all applicable fish windows imposed by the regulatory agencies. Timing restrictions will be imposed to avoid in-water work when salmonids are most likely to be present. Work in the Ship Canal is restricted from April 16 through September 31 for the protection listed species. In-water work will be limited by contract to the period between October 1 and April 15. The SMP will also obtain a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) and adhere to all conditions of the HPA.

The potential impacts of driving piles would be minimized by using appropriate construction methods, including BMPs to minimize resuspension of bottom sediments and fish exposures, and by using cofferdams or bubble curtains surrounding each driven pile to reduce the transmission of noise energy to the surrounding water avoiding levels that could potentially be injurious to fish. Use of cofferdams would avoid noise impacts to fish. In the low current velocity of the Ship Canal, bubble curtains are likely to be effective in reducing energy transmission below levels that would injure hearing in fish or produce tissue damage in swim bladders.

Mitigation for impacts due to construction of new support columns at the Ballard Crossing, could include improvement of habitat functions within the currently degraded conditions of the existing Ship Canal or other locations. Potential mitigation measures include removal of man-made structures along shorelines or in the water that provide predator habitat (smallmouth bass) or potentially interfere with migration such as docks. Mitigation could include shoreline restoration of more gradual slopes and natural substrates such as sand and gravel, or excavation of shorelines to provide new shallow water habitat.

Mitigation for construction impacts could take the form of either improvement in existing habitat conditions, shoreline habitat improvement, or excavation of an existing upland area in the general vicinity of the bridge to construct new shallow water habitat and restore the reduced habitat functions. Potential mitigation options for impacts to aquatic habitat include construction of natural habitat characteristics along one or both shorelines under the proposed monorail bridge over the Ship Canal to improve habitat

and survival for juvenile salmon. Natural shoreline characteristics could be constructed at another location along the Ship Canal or elsewhere in the same general area if approved by the resource agencies where land uses provide an opportunity (not yet identified). Mitigation could also involve participation in proposed actions to improve survival of juvenile salmon migrating through the Chittenden Locks. Mitigation could involve support for experiment projects or investigations by others to improve habitat conditions and survival of aquatic species.

As discussed in Section 4.15, mitigation for long-term impacts from removal of offshore benthic and water column habitat within the Ship Canal could include construction of habitat supporting other functions or by improvements in the general habitat of the Ship Canal. The following are possible mitigation options and would be evaluated with permitting and natural resource agencies:

- Removal of the creosote treated timber fender system protecting the Ballard Bridge and reconstruction with non-toxic rubber, steel, etc. concrete structures (general habitat improvement by toxics removal).
- Shoreline habitat improvement by removal of man-made structures, construction of moderate gradient slopes and sand-gravel substrate in shallow water less than six feet deep (improved habitat supporting migrating juvenile salmon).
- Excavation of uplands to produce new shallow water habitat that is missing along most of the Ship Canal shoreline (new habitat supporting migrating juvenile salmon).
- Participation in a habitat improvement project proposed by another entity for the Ship Canal or the biological resources supported by the Ship Canal habitat (improved survival conditions for juvenile salmon).

These options are currently being explored in the general vicinity of Ballard Bridge crossing location. However, other locations along the Ship Canal are likely to be of equal value to the biological resources.

Segment 3: Queen Anne/Seattle Center/Belltown

Mitigation for removal of landscaping and street trees could include replacement of the vegetation removed if appropriate. This would be decided on a case-by-case basis depending upon the type and location of plantings affected.

Segment 4: Downtown/Pioneer Square

The redwood tree on Stewart Street would be protected during construction if possible, or it may be trimmed or replaced. Appropriate mitigation measures would be determined based on construction conditions.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Mitigation for removal of landscaping and street trees could include replacement of the vegetation removed if appropriate. This would be decided on a case-by-case basis depending upon the type and location of plantings affected.

Segment 6: West Seattle

Duwamish River. Construction impacts to fish will be minimized by adhering to all applicable fish windows imposed by the regulatory agencies. Timing restrictions will be imposed to avoid in-water work when salmonids are most likely to be present. In-water construction at the Duwamish East Waterway

crossing location would not be conducted during the spring juvenile Chinook migration period. The work window for this location restricts in-water work to the period between August 1 and August 31.

The SMP will also obtain a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) and adhere to all conditions of the HPA.

The potential impacts of driving piles for a temporary trestle would be minimized by using appropriate construction methods, including BMPs to minimize resuspension of bottom sediments and so that exposures are minimized, and by using cofferdams or bubble curtains surrounding each driven pile to reduce the transmission of noise energy to the surrounding water avoiding levels that could potentially be injurious to fish.

Construction of the temporary trestle or segmented barge over a portion of the East Waterway under the West Seattle Bridge would potentially reduce photosynthesis and bull kelp distribution at this location. Since the bull kelp bed does not currently exist and such beds do not consistently occur at all locations, it is unlikely the impact would be more than temporary. Mitigation could be placement of small boulders as substrate for future bull kelp. Mitigation could also be improvement of riparian shorelines through grading and planting of native species along the currently bare shoreline.

Pigeon Point Greenbelt. Construction of Alternative 6.1.2 would remove some trees and occupy space within the Pigeon Point greenbelt of West Seattle. Assuming all vegetation within 50 feet either side of the Green Line alignment centerline would be removed by construction activities, an area of up to 50,000 square feet would be disturbed. Mitigation could include replanting within this area or replacement of this habitat type at another location. Selection of Alternatives 6.1.1 or 6.2 would avoid the impact to the Pigeon Point vegetation. Potential mitigation would be commensurate with the type and extent of impacts.

Longfellow Creek. Construction of Alternative 6.1 could potentially impact a portion of the buffer of Wetland A (see Figure 4.15-1), and Alternatives 6.4 and 6.4(s) could potentially impact Wetland B's buffer. If a guideway column is located in a wetland buffer area, mitigation would be required by the City of Seattle or Department of Ecology regulations. Total area of the buffer impact for each of these alternatives would likely not exceed 115 square feet. With Alternative 6.1 construction of the Delridge station would potentially remove a small amount of vegetation at the periphery of the riparian area adjacent to the Longfellow Creek culvert entrance immediately south of SW Andover Street. At this location, natural riparian vegetation and recent landscape plantings. Mitigation for any perceived impact on Longfellow Creek could include additional habitat improvement measures to or along the stream channel or limitations to human access near the Green Line crossing. Mitigation for construction impacts in this general vicinity could be actions to improve aquatic and/or riparian habitat in the Longfellow Creek corridor for Alternative 6.1.

4.17.17 Cumulative Impacts and Mitigation

4.17.17.1 Impacts

SMP would coordinate construction activities with the City of Seattle, King County Metro Transit, WSDOT, the Port of Seattle, and other agencies that are planning projects in the same vicinity as the Green Line. Despite these coordination efforts, temporary cumulative impacts could occur by increasing the intensity or duration of construction-related impacts. Table I-6 in Appendix I, Projects to Consider for Cumulative Impacts Analysis, lists 70 projects in or near the Green Line project area that are expected to be constructed in the next 10 years. Public agencies such as Sound Transit, WSDOT, City of Seattle, King County, Seattle Public Schools, and Port of Seattle have provided information to the SMP on their planned projects. Private development projects have been identified by DPD through the Master Use

Permit application process. Limited information, such as funding status and construction timeline, is available on these projects. The construction dates for all projects listed in Appendix I could change due to funding or other project variables.

If construction on the projects in Appendix I (or other unforeseen projects) occurs in the same time frame as construction of the Green Line, cumulative construction impacts could occur in the following areas:

- Ballard (five private development projects)
- Interbay (City of Seattle transportation projects including the Magnolia Bridge project, potential Galer off-ramp to Elliott, Port of Seattle North Bay Master Plan, Seattle City Light Interbay Substation, four private development projects, including the Amgen Helix Centre)
- Seattle Center/Queen Anne/Belltown (King County Metro Transit, City of Seattle, and City of Shoreline Aurora Avenue North Multimodal Corridor Project; South Lake Union Improvements [including Mercer corridor improvements, South Lake Union Streetcar, and Potlatch Trail]; Memorial Stadium Improvements; 17 private development projects)
- Downtown (Sound Transit Light Rail, Convention Place Transit-Oriented Development, Alaskan Way Viaduct, King Street Renovation, King County Combined Sewer Overflow Improvements, Weller Street Bridge Reconstruction, 20 private development projects, including Seattle Art Museum/Washington Mutual Project)
- SODO (City of Seattle/WSDOT transportation projects, BNSF/Sound Transit rail improvement projects, Amtrak Maintenance Facility Upgrade, King County Metro Transit Atlantic, Central, and Ryerson Maintenance Base Expansions, King County Metro Transit Power Distribution Headquarters Replacement, Alaskan Way Viaduct, Port of Seattle E Marginal Way Grade Separation and Terminal 46/Pier 48 development projects)
- West Seattle (seven private development projects)

The WSDOT/City of Seattle Alaskan Way Viaduct project, Sound Transit Light Rail project, South Lake Mercer corridor improvements, South Lake Union Street Car Project, and the Green Line project could affect the Downtown Segment during their construction if they have overlapping construction periods. Construction of the Green Line on Second Avenue could involve lane closures; increased truck activity, traffic congestion and delays; loss of parking; and detours. This could cause an increase in traffic congestion along Second Avenue from Stewart Street to S Jackson Street, particularly if the Green Line is constructed at the same time as the Link Light Rail project. The Seattle Department of Transportation (SDOT) has stated that it will ensure through the construction permitting process that all construction schedules are coordinated and that all agencies work together with the City, to minimize disruption. SDOT is initiating an ongoing construction management program.

Closing the Alaskan Way Viaduct for construction would further increase traffic through Downtown Seattle as well as north and south of downtown. Construction dates for the Alaskan Way Viaduct project have not yet been determined and appear likely to occur after completion of the Green Line in Downtown Seattle. A best case scenario for the Alaskan Way Viaduct Project indicates that groundbreaking construction could occur as early as January 2008 and some above-ground utility relocation work could occur as early as December 2006. These utility relocations could involve some lane closures during Green Line construction, potentially resulting in cumulative construction impacts in Downtown Seattle.

Construction of the Light Rail project could occur at the same time as Green Line construction. Retrofit of the Downtown Seattle Transit Tunnel (DSTT) to joint bus and light rail operations would require rerouting the buses that use the tunnel to surface streets. This would occur for approximately two years some time between 2005 and 2009, although Sound Transit has recently announced plans to close the

DSTT for approximately 18 months beginning in 2005. If the Green Line is in place before the Alaskan Way Viaduct and light rail projects are constructed, it could help the traveling public avoid traffic impacts from the other projects. If Sound Transit proceeds with an early tunnel retrofit option in 2005 rather than 2007, it is possible the tunnel could be reopened to buses in late 2007. If DSTT construction, and bus displacements to surface streets, overlaps with Green Line construction, this would have significant cumulative impacts to traffic on Second Avenue, especially at Second Avenue and Spring Street and Second Avenue and Columbia Street, unless construction is well-coordinated. SMP would work with SDOT and Sound Transit to phase construction on Second Avenue to coordinate with the tunnel retrofit in a way that minimizes disruption and traffic congestion on Downtown streets.

If construction of these projects takes place at the same time, there would be temporary impacts to traffic congestion and parking (congestion, delays, detours, loss of parking). These impacts in Downtown Seattle could be severe in construction areas and nearby arterial streets and intersections. Bus routes and stops along Second Avenue between Stewart Street and Jackson Street, and along Stewart Street between Fifth Avenue and Second Avenue would need to be temporarily relocated to First Avenue, Third Avenue, or another location. This would affect bus routes and schedules of southbound buses on Second Avenue; however, northbound buses on these routes are on Fourth Avenue and would not be affected by Green Line Construction. Depending on construction timing, the temporary relocation of bus routes along Second Avenue from Green Line construction could benefit from bus transit improvements on Third Avenue. These improvements were identified by Sound Transit, King County Metro, and the City of Seattle to accommodate the additional surface street buses during construction of Link Light Rail in the Downtown Seattle Transit Tunnel and include signing and pavement striping to prohibit non-transit vehicles from using Third Avenue for more than one block.

SMP is a member of the Downtown Seattle Quick Response Team, which is part of both the Transit Integration Group Service and Facilities Planning Committee and the Transit Integration Group Operations Committee. Staff from Sound Transit, King County Metro, and five other regional transit agencies are also on this team. One of the group's goals is to have an integrated and coordinated regional transit system; and coordination of projects would come under that goal. SMP has established quarterly meetings with the Directors of SDOT, Sound Transit, and King County Metro to ensure continued coordination as projects for each agency move forward. The Downtown Seattle Quick Response Team will work with the Monitor and Maintain Committee that was established to review various measures for Light Rail construction mitigation, and to determine which improvements benefit downtown transit and general-purpose traffic operation.

The cumulative effects listed below, such as impacts to emergency services, public services, visual quality, air quality, noise, and businesses would be of greater intensity and longer duration in the Downtown Segment. The following cumulative construction impacts could occur where other projects are constructed near Green Line construction sites:

- Increased construction noise and vibration impacts.
- Increased impacts from demolition (air quality, noise, vibration).
- Increased air quality impacts from construction-generated dust and emissions.
- Increased risk of erosion and water quality impacts where construction would occur, especially in geological hazard areas, near water bodies, or where construction phasing (to minimize conflicts between projects) would require earthwork during the wet season.
- Prolonged construction periods related to the Green Line and the other major transportation projects could have a temporary dampening effect on development and redevelopment activities until the projects are completed.

- Increased truck traffic, increased or extended temporary road closures, and increased or extended reroutes.
- Prolonged visual and aesthetic impacts.
- Increased traffic congestion, detours, and delays.
- Additional temporary parking loss.
- Increased impacts to businesses, residences, and economic development in localized areas, including reduced levels of business activities; some businesses may experience hardships.
- Further limitation of access due to lane and sidewalk closures could provide a disincentive to travel through some neighborhoods and use community facilities such as libraries and community centers.
- More extensive temporary habitat and wildlife impacts due to temporary clearing, disturbance, and in-water work.
- Further compromised temporary fire and emergency medical and law enforcement response times due to temporary lane reductions or closures. In some cases, emergency vehicles may need to take alternate routes to avoid major construction delays. Avoiding construction during peak periods would also help to minimize this impact.
- Services such as buses and solid waste pickup would experience further rerouting and traffic delays.
- Additional delays and revisions to school bus routes and stops.
- Increased demand for police and/or security personnel to provide general safety and security services and traffic control.
- Increased temporary utility service interruptions.
- Prolonged utility relocation durations and further reduction of places to relocate utilities.
- Increased impacts to historic resources such as noise, visual, and vibration effects.

Specific cumulative impacts would depend on the construction methods, phasing, and intensity of projects in combination with Green Line construction. As noted in Chapter 3, Project Description and Alternatives, detailed construction plans are not available at this (conceptual engineering) phase for the Green Line nor for most other projects that could be constructed during the same time period. As the design progresses for the Green Line, SMP would further define the construction approach and develop a construction plan. Construction would be coordinated with the City of Seattle, WSDOT, King County Metro, the Port of Seattle, Sound Transit, and other agencies and institutions so that phasing and methods would minimize conflicts and potential cumulative impacts. As noted above, these measures would be further developed as the design progresses into final design and construction.

4.17.17.2 Mitigation

The mitigation discussed in Sections 4.1 through 4.15 and 4.17 applies to the cumulative impacts identified above. SMP would work with the proponents of other projects to minimize cumulative impacts. In particular, coordination among King County Metro Transit, City of Seattle, Sound Transit, WSDOT, and SMP on the Green Line, Link Light Rail, Alaskan Way Viaduct and Sea Wall Reconstruction, Mercer Corridor Improvements, and South Lake Union Streetcar projects would be important. Coordination among these agencies could be implemented through the Transit Integration Group, Downtown Seattle Quick Response Team, and Monitor and Maintain Committee. With

mitigation and coordination, no significant adverse impacts would be expected to occur other than those previously mentioned in Sections 4.1 through 4.16.